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Thirtieth Annual Report

OF THE

Department of Scientific and Industrial Research

Presented to the House of Representatives by Leave

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MINISTER'S STATEMENT

THE reports of the Department of Scientific and Industrial Research and of the Council of Scientific and Industrial Research for the year ended 31 March 1956 are presented herewith.

I am greatly indebted to the Council of Scientific and Industrial Research and its specialist advisory committees for the valuable advice and guidance they have given me on many matters in addition to performing their special statutory functions. Members of the council and its committees have given generously of their time and have brought their scientific knowledge and wide experience to the consideration of a number of important problems relating to research in the agricultural and manufacturing industries of the Dominion.

I am of the opinion that an annual account of the deliberations of the council, dealing in the main with matters of broad policy, would be of value to the Government and I have therefore much pleasure in presenting for the first time a special report of the council.

I should like to take this opportunity of expressing my appreciation of the services of Dr J. C. Andrews and Mr E. J. Fawcett, who have retired from the council in accordance with the policy of rotation of membership, and of thanking them for the time and thought they have given to the work of the council. Their places have been filled by the appointment of Dr J. S. Watt and Dr J. F. Filmer, who respectively bring to the council their wide knowledge and experience of research in industry and in agriculture.

Although there has been little expansion of the work of my Department in the year under review I have to report the setting up at Kaikohe of a substation of the Grasslands Division. Its work will be to investigate the special problems of pasture establishment and maintenance in the subtropical environment of Northland and on the many and varied soils peculiar to that region. The new substation is situated on the grounds of Northland College and my thanks are due to the college authorities for making land and facilities available.

I am pleased to be able to state that New Zealand is to make a significant contribution to the work of the International Geophysical Year 1957–58 and that my Department, with other Government agencies and the university colleges, is now preparing the New Zealand programme which will cover operations in this country, the Antarctic, and the tropics.

I wish to draw attention to reorganisation in two branches of the Department. The Chemical Laboratory associated with the Grasslands Division has been constituted from 1 April 1956 as a separate branch with the name of Plant Chemistry Laboratory. The Department in acceding to a request by the Cawthron Institute Trust Board assumed from 1 April 1956 full control of the work of the Entomological Research Station, which will now be known as the Entomology Division. Since 1948 the station has been operated jointly by the Department and the Cawthron Institute.

Once more I wish to thank the staff of the Department for their loyal and efficient work in many fields of research and in service for the Government.

R. M. ALGIE,
Minister in Charge of the Department of Scientific and Industrial Research.

REPORT OF THE COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The Hon. R. M. ALGIE, Minister in Charge of the Department of Scientific and Industrial Research.

WE have the honour to submit herewith a report on the work of the Council of Scientific and Industrial Research for the year ended 31 March 1956.

In 1926 the Government invited Sir Frank Heath, the Secretary of the Department of Scientific and Industrial Research in the United Kingdom, to report on the organisation of scientific research in New Zealand. His report recommended the establishment of a new Department to take over the scientific units then controlled by a number of different Departments, and the appointment of an advisory Council of Scientific and Industrial Research "to encourage scientific research and to organise its application to the primary and secondary industries". These recommendations were embodied in the Scientific and Industrial Research Act 1926, and the council held its first meeting in October 1926.

The functions and duties of the council are stated in section 10 of the Scientific and Industrial Research Act 1952, as follows:

"10. (1) It shall be the duty of the Council—

"(a) To consider and report to the Minister upon the scientific aspects of all proposals made to the Department for the encouragement and organisation of scientific and industrial research:

"(b) To submit annually to the Minister a programme of the work, with estimates of the cost thereof, for each of the scientific institutions and services under the control of the Department:

"(c) To make recommendations as to the expenditure of money by the Department in grants for purposes of scientific research:

"(d) To advise the Government on the scientific aspects of any proposals made by any other Department of State and referred to the Council for its consideration and recommendations."

The council consists of a chairman and not more than eight other members, not more than two of whom may be "officers employed in the service of the Government". The membership of the council at 31 March 1956 was:

D. F. Sandys Wunsch, M.A.(Oxon.), B.Sc.(McGill), M.I.Chem.E., Assoc.Inst.M.M., F.N.Z.I.C. (Chairman).

G. A. Currie, B.Sc.(Agr.), D.Sc., Hon. LL.D.(Aberdeen), Hon.Litt.D. (Western Australia), Hon. LL.D.(Melb.) (Deputy Chairman).

M. M. Burns, M.Sc.(N.Z.), Ph.D.(Aberdeen), F.N.Z.I.C.

J. F. Filmer, D.V.Sc.(Melb.).

E. R. McKillop, C.M.G., O.B.E., M.I.C.E.

E. Marsden, C.M.G., C.B.E., M.C., D.Sc.(Manc.), Hon.D.Sc. (Oxon.), M.I.E.E., F.R.S., F.R.S.N.Z.

H. D. Purves, M.Sc., M.B., Ch.B.

D. M. Rae, M.A., Dip.Ed., F.R.Hist.S., M.P.

J. S. Watt, M.Sc., D.Phil.(Oxon.).

W. M. Hamilton, M.Agr.Sc., D.Sc., N.D.H.(N.Z.) (Secretary).

Dr J. C. Andrews and Mr E. J. Fawcett retired on rotation on 31 December 1955 and the vacancies were filled by appointment of Dr J. F. Filmer and Dr J. S. Watt for a period of four years from 1 January 1956.

Your council held five meetings during the year, the July meeting being held in Auckland and the November meeting in Christchurch to enable members to inspect the work of the Department's branches in those two centres.

There are now fifteen separate research units in D.S.I.R. with, in addition, three research associations which operate as departmental units though industry contributes half the cost and has representation on their advisory committees. There are also six incorporated research associations in receipt of grants from the Department. It is one of our duties to endeavour to maintain a proper balance in advising you what support should be given to each of the activities above and what grants should be provided for sponsored research at the university colleges, Cawthron Institute, etc. In the case of the research associations our difficulties are eased by the adoption of general principles for their financial support based on the contributions forthcoming from industry. With many industries there are also yard-sticks such as numbers employed, or turnover, which help to decide upon the magnitude of the scientific effort which should be devoted to their problems. But for the most part the considerations affecting the Department's research units are not so easily assessed and it is not possible to find any quantitative basis on which to determine the finance which ought to be made available to one research unit rather than to another; for example, to Grasslands Division rather than Soil Bureau or vice versa. We have no hestitation in saying, at present, that many units in the Department could use greater resources with advantage to the State.

At the same time we are aware that there are a number of fields where science could render valuable assistance in the solution of important problems and where little or no work is at present being undertaken. We would instance building research, road research, and nuclear research as three major fields of scientific activity where the present level of activity falls short of what we consider desirable for the needs of the country.

Expenditure by the Department in 1955–56 is shown in the table below.

Table of Expenditure, 1955–56

Branch	Staff, 31 March 1956	Salaries	Other Expenditure,	Total Expenditure, 1955–56	Voted, 1955–56
		£	£	£	£
Head Office	77	59,795	11,004	70,799	68,870
Animal Ecology Section ..	7	5,013	1,905	6,918	8,130
Applied Mathematics Laboratory	15	11,910	1,368	13,278	13,210
Auckland Industrial Development Laboratories	29	24,382	8,619	33,001	32,690
Botany Division	19	17,534	6,663	24,197	27,190
Crop Research Division ..	43	29,892	16,381	46,273	45,970
Dominion Laboratory ..	149	109,341	48,718	158,059	158,380
Dominion Physical Laboratory ..	170	119,041	60,055	179,096	185,720
Entomological Research Station	13	9,185	8,510	17,695	17,940
Fats Research Laboratory ..	17	13,591	3,655	17,246	18,140
Fruit Research Station ..	22	18,095	16,131	34,226	32,360
Geological Survey	61	45,644	17,570	63,214	62,930
Geophysics Division	69	54,664	48,725	103,389	99,820
Grasslands Division	87	62,563	34,562	97,125	89,020
Hop Research Station	3	2,716	6,469	9,185	8,900
Information Bureau	23	15,607	19,866	35,473	42,510
Plant Diseases Division ..	53	43,703	20,246	63,949	62,230
Scientific Liaison Services ..	3	7,061	3,442	10,503	11,050
Soil Bureau	73	59,807	20,095	79,902	76,580
Tobacco Research Station ..	5	3,799	3,925	7,724	7,890
Wheat Research Institute ..	8	7,705	1,866	9,571	10,180
Research General	..	..	10,506	10,506	10,881
Scholarships	..	..	6,479	6,479	7,000
Miscellaneous	..	..	216	216	300
Grants—					
Universities and agricultural colleges	..	..	31,980	114,634	112,109
Incorporated Research Associations	..	..	47,210		
Statutory and miscellaneous ..	..	..	35,444		
	946	721,048	491,610	1,212,658	1,210,000
Less recoveries	..	..	..	63,757	64,000
Net expenditure	..	..	..	1,148,901	1,146,000

In order to place the above table in perspective, figures for the last seven years and estimates for 1956–57 are shown in summary below, together with a column showing the expenditure of D.S.I.R. as a percentage of the gross national product (national income).

Year	Total Staff at 1 April	Gross Expenditure	Cost Per Staff Member	Gross National Product	D.S.I.R. Expenditure as Percentage of National Product
		£(000)	£	£(m.)	
1949–50	939	959	1,021	556	0·173
1950–51	981	962	981	696	0·138
1951–52	997	1,096	1,099	722	0·152
1952–53	1,012	1,010	998	754	0·134
1953–54	931	1,089	1,170	834	0·131
1954–55	937	1,149	1,226	927	0·124
1955–56	928	1,213	1,307	*	*
1956–57	946	1,350†	*	*	*

* Figures not available. † Estimated (includes £56,000 for International Geophysical Year).

The actual staff employed on 1 April 1955 was 928, but provision was made in the estimates for 64 persons to fill vacancies existing at that date, giving a total of 992. By 31 March 1956 the Department had filled 18 of these vacancies, making the actual staff at that date 946, as shown above.

The staff at 31 March 1956 comprised professional 366 (372); clerical 160 (157); technical 370 (342); others 50 (56); figures for previous year in parentheses. A net loss of 6 professional staff was sustained during the year, so that the number of professional officers employed is now 46 fewer than the 412 employed at 31 March 1951.

No worthwhile research can be undertaken at all without men of high scientific ability, and your council has expressed grave concern at the steady loss of scientific talent from the country without a corresponding inflow from overseas. Exchange of scientists is desirable to broaden training and experience, but the continued departure of highly qualified men to overseas posts can only be detrimental to the future development of the country. We have continued to urge that scientific salary scales be brought into line with salaries for comparable posts in other Commonwealth countries. In our opinion this is essential if we are to maintain efficient research and scientific services to meet the needs of our developing economy. It is, therefore, with the greatest satisfaction that the council notes the revised salary scales as announced by the Prime Minister on 2 May.

Careful attention has been given during the past year to the building needs of the Department's research units. Many of the research units are in old and unsuitable buildings never designed to serve research needs. Valuable scientific specimens and records are housed in old wooden buildings which constitute a grave fire risk and provide poor and inefficient working conditions for staff. New space of 100,000 square feet is urgently required to properly house existing research units of the Department.

We are very gratified that after protracted negotiations a Meat Industry Research Institute has been formed and is proceeding to the appointment of a director. Council welcomes the establishment of this new institute to assist in the solution of problems affecting one of our major export industries. The institute has been recognised as a research association and subject to Cabinet approval provision will be made in the Department's estimates for 1956–57 for a grant in accord with the general principles laid down by Government.

After full consideration we strongly urged the establishment of a substation of the Grasslands Division in North Auckland. Cabinet approved the proposals submitted and the substation is being established on an area made available by the co-operation of the Principal and Governors of Northland College at Kaikohe. Its purpose is to enable the fundamental problems of pasture establishment and utilisation in Northland to be scientifically examined so that the pastoral potential of the province can be developed on a sound basis.

In the present age scientific and technological development is taking place at a faster and faster rate. All modern countries are finding it necessary to devote rapidly increasing portions of their total incomes to scientific research and development, lest they fall behind in the race. There are now few developmental proposals which do not carry with them major problems of a scientific nature. The normal financial, economic, and social considerations are not now sufficient as a basis for the final decisions of Government on many of its problems, and some account has also to be taken of their scientific aspects.

The council feels that it could be of further assistance to the Government in its consideration of certain problems of this nature.

D. F. Sandys Wunch, Chairman.

SECRETARY'S REPORT

The Hon R. M. ALGIE, Minister in Charge of the Department of Scientific and Industrial Research.

I HAVE the honour to submit herewith the annual report of the Department for the year ended 31 March 1956.

As from 1 April 1955 the Underwater Research Laboratory was transferred to Navy Department and D.S.I.R. is not now conducting any regular programme of classified research, though its officers are available for technical advice to the services when required.

Following the resignation of Dr J. Melville from the position of Director, Grasslands Division, it was decided to re-establish the Plant Chemistry Laboratory, which had been combined with the Grasslands Division when Dr Melville was appointed Director of the combined unit in 1951. Dr P. D. Sears has been appointed Director of the Grasslands Division and Dr A. Johns has been appointed Director of the Plant Chemistry Laboratory.

During the year approval was given for the establishment in North Auckland of a substation of the Grasslands Division. Northland College, at Kaikohe, offered a suitable area of land representative of two of the major soil types in North Auckland, and the substation is being established there. The Department is much indebted to the Board of Governors of Northland College for their help and assistance in securing a suitable site.

Dr L. I. Grange retired from the position of Director, Geological Survey, at 31 March 1956. He has been succeeded as Director by Mr R. W. Willett. I should like to record the Department's indebtedness to Dr Grange for his long period of service with the Department. He was largely responsible for establishing and developing the Soil Bureau to its present form and for the high place which it holds in the Commonwealth in soil research.

For the first time since leaving the London Liaison Office at the end of 1940 I revisited Europe last year and led the New Zealand delegation to the quinquennial Commonwealth Agricultural Bureaux Review Conference in June.

In August I attended the United Nations Conference at Geneva on the peaceful uses of atomic energy as leader of the New Zealand delegation. I also visited various research institutions in Britain and Europe.

RESEARCH

In the following section a brief review of work completed during the year is given. Items that appear to be of general interest have been selected, and are outlined in non-technical terms with sufficient background information to explain the significance of the work. No attempt has been made to cover all work completed, but a complete list of all scientific papers published during the year is given following the list of projects in each branch.

AGRICULTURAL RESEARCH

Effects of Climate on Pasture Plants—Climatic factors – including temperature, light intensity, day length, and rainfall – control the seasonal development of pasture plants and largely determine the yield of herbage. They also affect the quality of feed. A pasture that is generally safe and nutritious may under particular climatic conditions become extremely harmful and produce in stock diseases such as bloat, facial eczema, or staggers.

Because conditions are so complex and variable it has not been possible by studying plants in the field to determine accurately the effects of separate climatic factors. However, a new approach to this problem can now be made. Recent advances in artificial lighting, air conditioning, and temperature control make it possible to reproduce in cabinets any growth conditions occurring in the field. New Zealand workers have been in the forefront in these developments. Four such cabinets have been constructed at Grasslands Division for studying the growth of pasture plants. The artificial climates in these cabinets can be controlled accurately; the experimenter can submit his plants to whatever conditions he requires and then observe and measure the growth responses. For example, the effects of different intensities of light can be studied while all other factors are kept constant.

The artificial-climate cabinets are being used to determine quantitatively the effect of each climatic factor on the growth of important pasture species. Attention was first turned to the influence of temperature. Results showed that the optimum temperatures for growth of ryegrass, cocksfoot, Yorkshire fog, and browntop lie between 65° and 70° F. White clover and *Lotus major* grow most rapidly at approximately 75° F. and paspalum at 85° F. With all these grasses, except paspalum, temperature over a wide range had little effect on the rate of growth of an individual stem, but a pronounced effect on the rate of tillering (branching).

The cabinets are also being used in work aimed at determining precisely the conditions under which pastures produce the toxic substance causing facial eczema. One cabinet is employed for biochemical studies. The modern technique of paper chromatography and the use of radioactive tracers make possible accurate chemical analyses on very small amounts of material. Experiments in plant nutrition can now be carried out within the small space of a cabinet, where the same climatic conditions can be reproduced at any time of the year, and consequently the work can proceed with enhanced speed and accuracy. Experiments in iodine uptake by grasses and nitrogen exudation by clover roots have been carried out in this way.

More information on climatic conditions in pasture land is needed so that full use may be made of the knowledge gained from the study of plants grown in the artificial-climate cabinets.

Standard meteorological records are inadequate as a measure of the physical conditions under which pasture plants live. It is necessary to study the microclimate near the ground surface where the plant actually grows. The greatest extremes of temperature occur at the ground surface, where the sun's rays are intercepted during the day and heat is lost by radiation at night. It is in this region that the development of new roots, shoots, and leaves of pasture plants takes place. The tem-

perature in the surface soil may be over 30° F. higher than the temperature of the air at a height of 4 ft., where temperatures are recorded for normal meteorological purposes.

Special recording stations have been established throughout the country to measure the temperature and moisture content of the soil at different depths, the temperature and humidity at different heights above the ground, and the amount of light received by the plants. Such records are useful also to those engaged in forestry, cropping, and horticulture, and institutions engaged in studying problems in these fields are co-operating in the establishment of microclimatological stations. The wide range of latitude and altitude in New Zealand has made it necessary to establish twenty-five widely scattered stations in order to obtain representative records.

Much effort has been directed to the selection and breeding of pasture plants adapted to the New Zealand climate and to the development of pasture management practices that exploit the advantageous features of the climate and minimise its adverse effects. New impetus to this work will be given by the intensive study of the climate and its effects now proceeding at Grasslands Division.

Wheat—The new variety Arawa, designed to replace Dreadnought in South Canterbury and South Otago, has proved very satisfactory to farmers. It is non-shattering, high yielding, resistant to lodging, and can be direct-headed. In the recent dry season, yields of Arawa in commercial crops have been equal to those of Dreadnought. Next season enough seed of Arawa will be available for the variety to be widely grown in Dreadnought country.

Breeding for quality has been greatly facilitated by the adaptation to single-plant testing of an American test for quality in bulked wheat. By using this Zeleny test we can screen thousands of plants in a high-yielding bulk to find the rare high-yielding good-quality plants. As a result of this test it is expected, after current trials have been completed, that a new general-purpose wheat will be released by Crop Research Division as a replacement for Cross 7. The new selections show promise of a substantial increase in yield over Cross 7, with no loss of baking quality in the flour produced.

Potatoes—A method has been found for freeing potato plants from virus Y. This involves growing potato sprout tips in culture, incubating them at 35° C. for three weeks, removing the tip of the new growth, and subculturing it on nutrient agar. There should be no difficulty now in obtaining sufficient stocks free from virus Y of the variety Auckland Short Top, commercial stocks of which are wholly infected. Various methods are being tried to eliminate virus X from this and other varieties, but in case this is not successful, those clones with the mildest strain of the virus are being selected for propagation. Complete immunity to all strains of viruses X and Y has been transmitted successfully to a number of hybrid progeny, so that the prospect of producing immune commercial varieties appears to be bright. The importance of blight resistance is illustrated by the yields of hybrids known to have similar yielding ability when healthy, but with differing resistance to blight: susceptible hybrids yielded as low as 8 tons per acre, resistant ones as high as 40 tons per acre in plot trials.

The potato-growing season at the Crop Research Division, Lincoln, has been extremely dry, with little useful rain for early and mid-season varieties. Overhead irrigation was used on half of an area (of over half

an acre) containing five varieties, supplementing rainfall to give 1 in. of water per week at weekly intervals from 15 December to 19 January, and then fortnightly to 20 February. More water could have been applied as evaporation over the period was 1½ in. per week, and an earlier application (mid-November) would have encouraged more tubers to set. Nevertheless, yields varied from 2 to 5½ tons per acre of table plus seed potatoes from the dry area to 9 to 12½ tons per acre from the irrigated area. In this trial irrigation made the difference between loss and profit, and it is suggested that much higher yields could have been obtained with more water. The soil must be in good condition to stand up to irrigation, but as a great many irrigation plants have been sold to farmers in Canterbury this last season, it is likely that there will be an increase in the area of potatoes irrigated in the future.

Ryecorn—Ryecorn and oats are the two main cereal green feeds grown in New Zealand, with annual sowings of about 55,000 acres. Ryecorn has increased in acreage from virtually nothing in 1946 to one-quarter of the cereal green feed area, and is valuable as winter pasturage for ewes and cows, for it provides green forage for stock at a time when little is available from other sources. N.I.A.B. Ryecorn has become the main variety grown because of its high yield of good quality forage and good recovery after hard grazing. Selection within the variety has been carried out for some years at the Crop Research Division, and seed of an improved line was recently handed to the Department of Agriculture for multiplication and release under certification.

Vegetables—The soil disease known as pea wilt can cause serious loss to growers, and for some time Crop Research Division has been working to produce resistance lines of the main pea varieties. Wilt-resistant Green Feast seed has now been released to merchants. Seed of our improved line of Best of All Savoy Cabbage will also be widely grown next season.

Frost Action in High Country Soils—In the montane tussock grasslands of the South Island observations by officers of the Soil Bureau have shown that soil freezing is one of the major factors delaying regeneration of vegetation. The most destructive form of freezing is marked by the appearance in the top inch of the soil of long ice crystals or "needles". These grow at right angles to the surface and attain lengths of almost an inch in a single night.

The rapid alternations of freezing and thawing of the soil, which produces needles of ice, do not occur under plant cover at Molesworth Station. The soil underlying tussocks of *Festuca novae-zelandiae* suffered an overnight heat loss which ranged from one-fifth to two-thirds of the loss from adjoining bare soil – depending on the size of the tussock. This insulating action of plants was reflected in the extent of ice formation in the soil: under continuous leaf-cover more than 2 in. in diameter ice crystals were limited to small, scattered grains, but where the vegetation had been destroyed masses of ice needles appeared. The ice needles break the roots of seedling plants or heave them bodily out of the ground, and are responsible for many failures in oversowing tussock grassland. On slopes of about 10°, stones subject to needle-ice action travelled downhill at an average rate of several inches a year. Stone stripes, common in the area, appear to mark the streamlines of downhill movement.

Since needle ice forms only on bare soil and makes the re-establishment of vegetation very difficult, it is of paramount importance to avoid management practices that deplete the existing plant cover. Young plants cannot be certain of surviving their first winter unless they can previously develop a canopy of leaves covering the ground for more than an inch around their roots.

Dental Caries – Soil Type Investigation—Differences in the mineral composition of pastures and milk produced on different soils in North Auckland, Hauraki, central North Island, and Taranaki are being investigated by officers of the Soil Bureau. This project arose from a general study of the incidence of dental caries in New Zealand school children carried out by Dr R. E. T. Hewat of the Health Department. The study suggested that the incidence of dental caries in rural children was high on some soils and low on others. The broad picture that emerged was that a high caries rate seemed to be associated with gley soils, and with the strongly weathered yellow-brown earths and podzols, while a lower caries rate seemed to be associated with yellow-grey earths, pumice soils, and moderately leached yellow-brown loams from andesitic ash.

One possible link between the soil and the child is the locally produced milk and vegetables which form a substantial portion of the diet of the young child. In order to study the possibility of such a link four areas were selected – two with high caries incidence and two with lower caries incidence. With the assistance of officers of the Department of Agriculture and the Dairy Board, samples of soil, pasture, and milk were taken under closely controlled conditions for analysis of major and minor elements. A dental research officer of the Health Department is co-operating by making a detailed study of the incidence of dental caries in school children in each area.

Although undertaken as part of an investigation into the cause of dental caries, this study should also yield basal information on the influence of our soils upon produce derived from them.

Manuka Blight—Manuka Blight (*Eriococcus orariensis*) continues to spread throughout New Zealand, e.g., during the year further extensive areas of manuka (*Leptospermum scoparium*) infested with the blight were found in western Southland by officers of the Entomology Division.

In South Island areas that have been infested for over ten years *E. orariensis* has survived on scattered plants of kanuka (*Leptospermum ericoides*), whereas in these same areas manuka (*L. scoparium*), which is the species that encroaches on farming land, has almost completely disappeared, and it is difficult to find even seedling plants of manuka still surviving. This illustrates how the destructive power of the blight is persisting in such long-infested areas and how this destruction is becoming progressive with the passing of the years.

Kanuka, although commonly infested with the blight, is not killed out, whereas manuka succumbs very readily. It has been found that this difference in susceptibility is associated with differences in bark structure. Manuka, with an exfoliated bark, can support high populations, whilst the smoother bark of kanuka limits the period for crawlers to become fixed. In the Gisborne region it has been found that a small proportion of the manuka plants have so far been able to survive attack by the blight, and it has been discovered that such plants are smooth barked like kanuka: this quality allows the growth of only small populations which are insufficient to kill the plants.

Mortality in Rata and Kamahi—In parts of Westland large areas of rata and kamahi are dead or dying, the damage often being so extensive as to cause alarm that such denuded areas might become seriously eroded. As part of an inter-departmental examination of the causes of this mortality, particularly in the protection forests of Westland, the insect complex associated with these trees was examined by the Entomology Division. A considerable number of insect species, especially scale insects, were found to be involved, but while locally they may be a serious factor, in general there was little difference in population levels in severely damaged and unaffected forests. The conclusion was reached that scale insects are not a primary factor in the widespread mortality of rata and kamahi.

Virus Disease in White Butterfly—Preliminary work indicates that field spraying of cultures of the common virus of white butterfly caterpillars has distinct possibilities in the control of this pest. A field survey in mid-Canterbury this year showed that the virus had kept caterpillar populations well under control in thirty-one different infestations, and much the same situation occurred in Hawke's Bay, Wairarapa, and Manawatu. For some years now it has been noted that this virus flares up in epidemic form in various parts of New Zealand. This work is designed to discover whether there is any way of artificially introducing the virus into the field so that it can be made to appear when desired. It is interesting to note that this same approach to the use of a virus has been made independently by some overseas workers, notably Dr K. M. Smith, of Cambridge, England.

Biological Control of Crucifer Pests—Surveys in both North and South Islands showed that both white butterfly and diamond-back moth are in general being held well in check by introducing parasites, e.g., pupae of white butterfly collected in the North Island showed heavy parasitism by the pupal parasite *Pteromalus puparum*.

There was a low incidence of diamond-back moth in all these areas; pupae of this moth were heavily parasitised by *Angitia cerophaga*. Adults of this parasite were frequently seen in the crops and there appears to be conclusive evidence that *Angitia cerophaga* is an excellent controlling agent in the districts surveyed, e.g., Hawke's Bay, Wairarapa, and Manawatu in the North Island, and generally in the South Island. Both *Pteromalus puparum* and *Angitia cerophaga* were introduced by the Entomology Division some years ago.

Predators of House Flies and Fly Pests of Stock—Tests are being made with predators imported from overseas against these fly pests. The fly menace has been greatly reduced in Fiji and Samoa by the introduction of the beetles *Copris incertus* and *Pachylister chinensis*. Liberations of these two predators have been made in both the Nelson and Whangarei districts by the Entomology Division, and evidence of establishment of both has been found in the field in Nelson.

It may prove that our winter climate is too severe for the predators, but if the experiment is successful they should be of great benefit.

Classification of New Zealand Flies—A systematic study of one group of New Zealand flies (Section Acalypterae) has been completed and a monograph prepared for publication by an officer of the Plant Diseases Division. Identification and recognition of flies in this group has always been regarded as difficult, and previous work on them is often inadequate.

The group contains many species of economic importance such as fruit flies, carrot-rust fly, and leaf miners. In all, 234 species are now known to occur in New Zealand, 37 of them are described as new and 17 are recent immigrant species recorded for the first time. The monograph with keys, diagrams, and descriptions will enable flies in this group to be easily identified. Discussions on the evaluation of the group in New Zealand are included.

D.S.I.R. Bulletin 114: Diseases and Pests of Peas and Beans in New Zealand and their Control—Peas and beans are grown extensively in New Zealand (a) for export and internal seed trade, (b) as field crops for canning, and (c) in market and domestic gardens as green vegetables. The successful production of these crops is largely dependent on efficient control of the many diseases and pests that attack them. Following many years of research at Plant Diseases Division, a bulletin of ninety-one pages, including seventy-three illustrations, has been published, which makes available a comprehensive account of diseases and pests of field and garden peas, dwarf and runner beans, and broad beans. Methods for their control by the aid of therapeutants, by use of resistant varieties, and by cultural practices have been recommended.

Death of Pine Trees—Mortality of *Pinus radiata* trees in shelter belts appears to be associated with the presence of the fungus *Phytophthora cinnamomi* in the soil of the root zone of affected trees. By the use of a special technique to test for the fungus, soil samples from diseased and healthy rows of pines and from adjacent open fields have been examined at the Plant Diseases Division. The percentage of infected samples rises from 0–10 per cent in open fields to as much as 80 per cent in the root zone of affected portions of shelter belts. Root symptoms are confined to death of fine absorbing rootlets, but this would be sufficient to explain wilting and death of trees through reduced uptake of water and nutrients. The fungus was absent from soil of some apparently healthy shelter belts examined, but was present in others – occurring usually at a low frequency. In some shelter belts where trees were not actually dying, unthriftiness (branch die-back, reduction in number and length of needles, and poor foliage colour) appeared to be associated with a high level of the fungus in the soil. Strains of *P. cinnamomi* have been shown to be pathogenic to one- to two-year-old pine trees. The prevalence of *P. cinnamomi* in the soil appears to be a factor involved in death and unthriftiness of pines, but climatic and soil factors most likely play an important part in development of symptoms.

Distribution of Lucerne Cultures—To secure satisfactory strike and establishment of lucerne under New Zealand conditions it is necessary to inoculate the seed with lucerne nodule bacteria. The availability of lucerne nodule cultures has enabled inoculation to become standard practice in the Dominion. Since the commencement of distribution of cultures in 1928, when sufficient cultures were forwarded to farmers to treat 7,000 lb. of seed, sales have increased steadily until, during the past year, cultures sufficient to treat 575,000 lb. of seed were sent to 3,495 farmers. Distribution of cultures over the last twenty-eight years has been largely responsible for the successful development of this valuable crop. With the introduction of a certification scheme for lucerne cultures, and now that a number of firms are offering efficient cultures for sale, it has been decided that the Plant Diseases Division shall cease distribution from 30 June 1956.

Certification of Legume Inoculants—Recent research illustrating the improvement in establishment of clovers on second-class and virgin land through the use of legume seed inoculants has created considerable interest, with the result that a number of New Zealand and overseas firms are now offering legume cultures for sale in the Dominion. In order that farmers should have information that would enable them to procure efficient tested strains of root nodule bacteria, a voluntary scheme for the certification of legume seed inoculants was inaugurated by the Plant Diseases Division on 1 September 1955. This scheme covers cultures for use with lucerne, and red, white, and subterranean clovers. Cultures submitted for certification are thoroughly tested in the laboratory, glasshouse, and field, and only those that pass all tests imposed are certified. The first list of certified commercial cultures was published in March 1956 and included eleven cultures for use with clovers and nine for use with lucerne.

Virus Diseases of Clover—A virus disease that appears to be similar to a disease recorded in North America has been found by the Plant Diseases Division to be widespread, especially in old pastures in the North Island. Glasshouse trials have shown that it causes yield losses amounting to 25 per cent in white clover (which usually shows no symptoms), 35 per cent in subterranean clover, and 50 per cent in red clover. The virus has been purified and an antiserum prepared. Use of the antiserum has facilitated field identification and has assisted with the search for resistant plants. There are indications that resistance may exist in white clover.

Control of Black Pod of Cacao in Western Samoa—Experiments carried out by the Plant Diseases Division on behalf of the Department of Island Territories during two seasons have shown that satisfactory control of Black Pod can be achieved by spraying with bordeaux mixture. The returns from increased yields make spray applications an economic proposition on native and commercial plantations.

Waxed-paper Liners for Pear Storage—All fruit held in cool store tends to lose water and to wilt when kept for long periods. This is particularly marked in long-keeping varieties of pears, and it is the cause of appreciable loss to the industry. Mr L. W. Tiller was able to show that the use of a waxed-paper liner inside the case markedly reduced wilting. As losses from wilt in Winter Cole pears have been increasing, the Fruit Research Station suggested that a large scale commercial trial be carried out during 1954–55. Results were striking, the percentage of wilted fruit being reduced from 68 to 15 by the inclusion of a single waxed liner. Reduction in wilting gave both a better quality and a heavier pear, as cases with liners were from 1 to 2 lb. heavier on removal from store than the unlined ones. The Apple and Pear Marketing Board took immediate action and specified wax liners for all Winter Cole pears packed during the current season. Experiments in progress will test the method for other varieties of pear and for some apple varieties.

Post Storage Ripening of Pears—A rapidly increasing crop of Williams' Bon Chrétien pears has created a difficult marketing problem as this variety has a short storage life. The Fruit Research Station co-operated with the marketing authority in experimental shipments to the United Kingdom and it was demonstrated that this variety could be exported for a limited season. One of the major difficulties was to ripen the fruit successfully on arrival. It has now been shown that Williams' Bon Chrétien

pears, hard and green on removal from cool store, will ripen well if held for seven days at a temperature of 50° to 55° F. This information makes successful export possible in glut years and has been put to immediate use in local canneries.

Transport of Orange Seed from the Cook Islands—Sweet orange seedlings are used as rootstocks for many of the citrus trees raised in this country. Seed is often obtained from waste fruit in shipments of Island oranges, but this is an unreliable source of supply. To overcome this difficulty the practice of extracting seed in the Islands is increasing, but this seed has been arriving in poor condition through shipping delays and faulty handling. The Director of Agriculture, Cook Islands, and the Fruit Research Station undertook a co-operative investigation to find a way of keeping orange seed in good condition during transport and storage. It has been found that freshly extracted seed packed in sealed polythene bags will keep in good condition for several months. This method of packaging has been adopted for the current season.

Supply of Peach Seed for Nurseries—Practically all the peach and nectarine and some of the apricot trees raised in New Zealand are budded on peach seedling stocks. Large numbers of peach stones are used annually by nurseries to produce these seedlings. Formerly, adequate supplies could be obtained from canneries, but introduction of new machines that split the stone and injure the seed caused a shortage. As stones from waste peaches infected with brown rot (*Sclerotinia fructicola*) offered an alternative source of seed, the Fruit Research Station carried out a series of trials to determine whether healthy seedlings could be raised from diseased fruits. Severe brown rot infection on Golden Queen peaches had no adverse effect on the seed. Provided that the stones were not allowed to dry out, good germination and vigorous normal seedlings were obtained.

Hop Research—With the official opening of the new office and laboratory building in February, the initial phase of establishment of the Hop Research Station is now completed. The first aim of the station has been to breed a new variety of hops attractive to growers and brewers and resistant to root rot (*Phytophthora*).

Crosses were made among a large number of varieties in 1952–53, and seed from these crosses provided 2,000 seedlings in the following season. These were artificially infected with *Phytophthora,* and those that survived were planted out. Of the 1,200 survivors there appear to be five or six plants that show considerable promise. It is hoped that they will prove resistant to root rot under commercial conditions; their yield is high and the quality of their cones is excellent when judged by the usual chemical tests.

Further crosses were made in 1953–54 and 1954–55 seasons and additional seedlings from these crosses are available for selection in the future.

From trials on the influence of cultural operations on the occurrence of root rot there are strong indications that the use of organic sources of nitrogen (dried blood or blood and bone) as fertilisers increases the number of hills lost by root rot in commercial gardens. It also appears that leaving the vines uncut and coiled round the hills increases the losses by root rot as compared with cutting the vines and removing them from the hills.

Tobacco Research—In recent years many new insecticides and fungicides have been developed. While many of these are much more effective than the older types, greater care is required in their use. Trials were carried out during the past season on tobacco seedlings to test their reaction to several of these materials. It was found that tobacco seedlings were very sensitive to lindane: distortion of the leaves occurred with even a slight variation from the recommended application. Phygon caused some delay in development, but parathion, malathion, dieldrin, and Pestox appeared to be quite safe.

Irrigation is becoming increasingly important in the growing of the tobacco crop. Further experiments confirmed that the moisture level of the coarser soils falls very rapidly in the summer months even after rain or irrigation, and a follow-up watering is necessary earlier than is usually realised. Under irrigation, advantage was secured from heavier applications of fertiliser.

Breeding for resistance to black root rot (*Thielaviopsis basicola*) has reached an advanced stage. Two highly resistant lines that yield well and have good agronomic characteristics are being grown on a semi-commercial scale to provide leaf for manufacturing tests. Good progress has been made in combining resistance to black root rot and to mosaic in the one variety, and lines carrying both characteristics are under field trial.

New Zealand Conifers—An intensive study has been made of the relationships and classification of the indigenous species of conifers, which include many of our most valuable native timbers – kauri, rimu, matai, kahikatea, etc. Many close relatives of the New Zealand species occur in Australia and the Pacific islands. A senior officer of the Botany Division made a rapid collecting trip to Fiji and New Caledonia to study these related species and collect material for further study. Cytological fixations and preparation of critical material had to be made in the field. This was made possible by the ready assistance of the French authorities and the South Pacific Commission. Living material of rare species of New Caledonia conifers was secured and brought back to New Zealand for further intensive study. It is the first time that any New Zealand botanist has been able by co-ordinating and taking advantage of such modern facilities as air travel, improved reagents, laboratory accommodation abroad, etc., to secure such favourable living material for propagation and study, and a much better understanding of the obscure affinities and phylogeny of the difficult genera to which New Zealand coniferous species belong should result. Similar valuable assistance in collecting material from allied species in Fiji was afforded by the agricultural officers of the Colonial Office in Fiji, to whom equal thanks are due.

Silver pine in Westland has been found to regenerate frequently by root shoots as well as by seeds. Whilst this may possibly be of local application in silviculture, it has a more widespread scientific significance in that this phenomenon has not before been recorded for any coniferous species. This work therefore has already attracted considerable interest in botanical circles.

Rabbit Population Studies—Some tests of the efficiency of arsenic and of sodium fluoracetate (1080) poisons were carried out by the Animal Ecology Section in co-operation with the Department of Agriculture. Populations of wild rabbits living in warrens were surrounded by rabbit-proof netting and then poisoned. Later, all the warrens were

dug out to determine how many rabbits had died underground and how many remained alive. The arsenic killed considerably fewer rabbits than the 1080, and the age and sex ratios of the survivors are of considerable interest. It was found that the arsenic had a selective effect and killed more males than females and more young animals than old ones. Although the sex ratio was roughly equal in the original population, the thirty-three survivors included only five males. These findings are of considerable practical importance because old rabbits tend to have larger litters than young ones, and one male may mate with several females. Thus, although the arsenic killed 77 per cent of the population of the arsenic pen, the survivors had an unusually high potential for making good the loss during the subsequent breeding season.

For the second time the bones of rabbits collected in the field showed that some animals had consumed sublethal doses of phosphorus when they were young. The study of bone development in rabbits is of great importance in developing methods of age determination and is also proving useful in assessing the efficiency of control operations involving the use of phosphorus.

Accompanying the application of energetic control measures the abundance and distribution of rabbits have been declining in New Zealand over recent years. Data collected since 1950 show that breeding success may be greatly modified by peculiarities of season and locality, and no uniform trend is yet apparent for the period as a whole. However, accompanying the decline in the rabbit population there has been a marked and uniform decline in the incidence of at least two species of rabbit parasites and this decline is apparent even in places where rabbits remain numerous. A possible explanation for this is that with the overall population being smaller the remaining rabbits live in better conditions, as a result of which they are more able to resist parasitic infestations. If this is so, we may expect better survival and higher rabbit populations in future unless control efforts are intensified.

Analysis of Pasture Records—To ensure the best use of pasture it is important to understand the rate at which it grows between grazings. An experiment carried out at Grasslands Division on a pasture consisting of short-rotation ryegrass, red clover, and white clover, shows how modern methods of mathematical statistics can be used to solve this problem in the most economical way. The problem was to disentangle the effects of temporary fluctuations in the weather from the main growth curve. One way of doing this would be to carry out the experiment in a great many different seasons, and then to take the average to eliminate the effect of the fluctuations, but this would be very costly and time-consuming. By staggering the trials within the same season, and using the appropriate statistical technique, known as fitting constants, to analyse the results, it was possible not only to obtain a clear picture of the rate of growth when undisturbed by weather fluctuations, but also to show in detail how the weather fluctuations affected the growth. This second aspect has additional value because it provides possibilities of correlating these changes in growth with specific climatic records such as rainfall and air temperatures, and so deciding the relative importance of these factors.

This method was developed by a member of the Applied Mathematics Laboratory for this particular experiment, but the solution was sufficiently general to apply to many other similar cases, and is capable of extension to more complicated problems.

SOIL TESTS FOR BUILDING FOUNDATIONS

A method of greatly reducing the time taken to make certain soil tests for building foundations is being developed. Soil will respond to the application of any load with some degree of compression and settlement, and the engineer designing a building must distribute the load to keep the settlement within allowable limits.

In the laboratory the universally adopted method of measuring both the rate and the final magnitude of the consolidation is by compressing samples of the soil between porous stones in contact with water, and measuring the progress of settlement as the load is increased. Increases in load are applied after the soil comes to equilibrium, generally at intervals of one to two days. The time needed for this test has limited it for the most part to large construction projects.

Investigations at the Soil Bureau have shown that for most New Zealand samples that have been tested the loading interval can be reduced to as little as twenty minutes instead of the conventional one to two days. This means that a test can be completed within one working day instead of a fortnight as at present. The technique is still experimental, but its development should, on the basis of the sites already tested, lead not only to a saving in cost and time per job but also to a release of equipment and staff, enabling wider application of the consolidation test. This in turn should lead to a closer estimate of projected settlements of many more buildings and the consequent wider use of more economical structural designs.

DOMINION LABORATORY

The Dominion Laboratory, established ninety years ago as a one-man laboratory, now has a staff of about one hundred and fifty. For the first time in its history the laboratory was thrown open to the public in December 1955. All sections, including those located at Gracefield, provided exhibits of their work. The exhibition aroused widespread public interest, and about 6,000 visitors crowded the congested premises during the four days. Visitors included several Cabinet Ministers, Members of Parliament, heads and staff of most Government Departments, the Mayor of Wellington and local body officers, university staff and students, and a wide section of the general public. The exhibition is believed to have fulfilled a valuable function in explaining the work of the laboratory to the public.

Fuel Utilisation Research—In New Zealand at present some two and a half million tons of coal and half a million tons of imported fuel oil are burned annually. Most of this fuel is used at an efficiency far below that which is practicable. A quite feasible improvement of ten per cent would save consumers some £2,000,000 a year. The net saving, however, that can be made in any single factory is not large, and there is thus no very strong incentive to the individual consumer to go out of his way to practise economy. Higher standards of fuel utilisation must, therefore, come in the main from gradual installation of combustion appliances of better performance, or from improvements in existing practices that do not demand any increase in skill or attention.

Fortunately, as a result of fuel-utilisation research in the United Kingdom, improved appliances are becoming available, but in that country there are no coals in use resembling our more common ones.

The under-fired horizontal return-tube boiler, or "Multitubular" as it is commonly known, is also the most common industrial steam producer in New Zealand, but is not used in Britain.

The Department has to date relied on tests of industrial boiler plant and on combustion trials with a miniature "pot" furnace to carry out the integration between analysis and practical use. Tests with industrial plant, although valuable, are normally so limited by the requirements of production and the impracticability of making major adjustments in equipment or fuel that only very slow and uncertain progress can be made. The pot furnace is a useful tool in establishing the combustion characteristics of a fuel, but does not sufficiently duplicate the conditions of industrial use for many purposes. To meet these limitations the Department has now installed a small but very fully instrumented boiler plant for combustion testing. An underfired multitubular boiler was chosen because, while it is a common type of boiler in New Zealand, no research work based on it is at present proceeding overseas. The external brick-set combustion chamber of this type of boiler allows a wide range of fuel-firing devices to be accommodated, and facilitates major modification to combustion volume or shape.

Of special interest will be work on sub-bituminous coals. These coals are comparatively little used overseas and very little has been published regarding their use in small steam-raising or central-heating plants. They are traditionally considered as inferior fuels, but their combination of a reasonable heating value with high reactivity, low ash, and non-coking characteristics suggests virtues which have not been fully exploited. New Zealand reserves of minable sub-bituminous coal measured and indicated are about 230 million tons, as compared with 70 million tons of bituminous coal. Sub-bituminous coals can be fired in some types of equipment designed primarily for the combustion of the highest ranks of fuel or even coke. The difference in composition between the highest-rank coals and sub-bituminous coal is, however, so wide that there can be little doubt that further study of the combustion characteristics of our coals will enable them to be used more effectively than with the currently available equipment.

The discharge of solid particles with the chimney gases of coal-fired boilers is another problem to be investigated. This is important not only in urban areas but in the dairy factories and in the firing of glazed ceramic ware. The experimental boiler plant includes a grit arrester of departmental design which it is hoped will prove to be well suited to the requirements of New Zealand small-scale industry. The manufacture of refractories for this type of boiler is a fairly large industry in New Zealand. In the experimental boiler, the brickwork of the combustion chamber includes most of the available New Zealand refractories, and for comparison with these some of the standard imported refractories.

Thus, while the boiler plant will be mainly used to extend our knowledge about the combustion characteristics of our coals, there will be opportunities in this work to resolve many related practical problems, which should lead to equipment of better efficiency being installed and a steady improvement in fuel utilisation in New Zealand.

Invercargill Water Supply—Trouble has been experienced for many years with corrosion by water from the wells supplying Invercargill, and a thorough investigation of the problem has recently been made by the Dominion Laboratory. Extensive analyses of the water from all the wells

were made, and the corrosiveness of the water, hot and cold, to a variety of metals and alloys was investigated. A special apparatus was set up at the waterworks to determine the corrosiveness of the water before and after treatment by several different methods, and the tests extended over several months. Economically practicable methods of treatment of the water to prevent corrosion were recommended and are now in operation.

Meat Research—Fundamental work has been continued on the chemistry of muscle, the relation between connective tissue and toughness in sheep muscles, and the structural proteins of muscle fibrils.

Bone taint in meat has been investigated and at least twelve different micro-organisms have been isolated from bone-tainted sides of beef. Some earlier theories have been disproved, and it is now suggested that gram-positive rods enter abrasions in the skin of cattle and become localised in the lymph nodes. After death the organisms multiply and spread outwards to neighbouring muscles and produce taint.

Bacon-curing investigations to determine the best conditions for the drying and smoking of bacon have continued. The work has the joint purpose of improving bacon quality and eliminating the use of boric acid as a preservative.

The new process of dehydration of meat developed several years ago in the laboratory has been extended to pilot-plant stage, and plans are now in progress for the building of a larger scale plant in a meat works. Supplies of the dehydrated product are being sent to Great Britain for trial, and will also be made available to organisations such as the Ross Sea Committee.

VOLCANOLOGICAL OBSERVATORY

The study of volcanological phenomena has always been of considerable interest to mankind, and until recently it has been studied only by geological and chemical methods. The development of suitable geophysical equipment in recent years has provided the possibility of understanding the mechanisms involved and the possibility of predicting eruptions.

As most volcanic areas are relatively inaccessible or are found in countries with a low standard of living, very little work along these lines has been carried out except in Japan and Hawaii. Studies along these lines in New Zealand would be particularly valuable, but have not been possible so far because the staff required has been engaged on hydro-electric dam site and geothermal steam investigations. An observatory near the Chateau is, however, practically completed, and several types of equipment will be in operation shortly. This observatory will be suitable as a base for studying the conditions of the crater lake of Ruapehu, which was responsible for the Tangiwai disaster. It will provide information concerning the activities of the volcanoes when they are obscured by cloud, and should also be of considerable interest to visitors to the Chateau.

OIL EXPLORATION

Effective oil exploration by well-recognised companies ceased in New Zealand during 1942 owing to repeated failure to find oil. Although standard methods of exploration were used and orthodox types of structures were drilled, in no area could the possibility of finding oil in commercial quantities be definitely disproved.

The work of the past was later reviewed in a lengthy report by Dr E. L. Lehner on behalf of the Anglo-Iranian Oil Company. This report suggested that the Taranaki area was the most attractive from the point of view of oil prospecting.

Although it is beyond the sphere of the Geophysics Division's work to carry out a detailed investigation of an oil field, it was nevertheless thought desirable to collect sufficient geophysical information to permit a reinterpretation of former work and so arrive at a new concept of oil possibilities in New Zealand. A detailed density examination of the drill cores of the Midhurst well in Taranaki, which reached a depth of approximately 11,000 ft., disclosed a density profile with far-reaching consequences on the interpretation of gravity data.

The seismic investigations carried out by former oil companies in Taranaki assumed a velocity distribution equal to that experienced in Texas. To improve on this assumption, well-velocity tests were carried out in the Omata well near New Plymouth to a depth of 3,000 ft., and seismic profiles were shot in various parts of the Taranaki Province. Extensive oil leases have since been taken up by major oil companies in the North and South Islands.

The work carried out by the Division in the Taranaki area has been of considerable value to the Shell, D'Arcy, and Todd Oil Surveys Limited, who are now engaged in prospecting observations in this area. The Division is also carrying out gravity and magnetic surveys as part of their exploration programme.

In the South Island a gravity survey of the Kotuku area near Greymouth has revealed another possible oil structure to the north of the Kotuku dome, where drilling has been carried out in the past.

INTERNATIONAL GEOPHYSICAL YEAR

The International Geophysical Year, which begins in July 1957 and ends in December 1958, will be the largest international scientific project ever undertaken. During this period scientists throughout the world will be observing meteorological, solar, and auroral phenomena, and studying radio propagation and cosmic rays.

As part of the New Zealand programme the Geophysics Division will be extending the ionospheric observations, which are normally carried out at Christchurch, Rarotonga, and Campbell Island, and will operate similar equipment at Scott Base in the Antarctic. Such observations are essential to the study of long-distance radio communication. Similarly the magnetic observations carried out at Christchurch and Apia will be extended and similar equipment installed at Scott Base.

Because of the range in latitude covered by these stations and the importance of these observations in studying conditions in the upper atmosphere, this work will form a very significant part of the world programme.

In addition, cosmic ray equipment will be operated at Christchurch and Invercargill, seismographs will be installed at Scott Base, latitude and longitude observations will be made in Wellington, and oceanographic observations carried out in the South Pacific area and *en route* to and from Scott Base in the Antarctic.

Equipment is being ordered and constructed to meet these requirements and plans drawn up concerning the type of observations that will be made.

The observation of radar echoes from auroral ionisation has provided a new tool in the study of the aurora, and the method has been employed to an increasing extent at a number of northern-hemisphere stations during the last few years. Radar observation of the southern-hemisphere aurora from Invercargill will be part of the New Zealand programme for the International Geophysical Year, and work has begun at the Dominion Physical Laboratory on modifying some surplus army radar equipment for the purpose.

As part of the New Zealand International Geophysical Year Programme a special transmitter is being built at the Dominion Physical Laboratory to be set up at Scott Base in McMurdo Sound. Automatic receiving equipment is being built also to observe the transmissions from Scott Base at some six stations in New Zealand, Tasmania, and on the Antarctic continent. The results should give much useful information on the propagation of radio signals through the auroral belt, a matter of considerable importance to long-distance communications.

URANIUM

During the year many people prospected for uranium and thorium. They received guidance from a pamphlet published by the Geological Survey branch. In November 1955 Messrs F. Cassin and W. Jacobsen reported finding a radioactive deposit on the roadside near Batty's Creek in Buller Gorge. Analysis of specimens showed that the rock contained sufficient uranium for economic working if the deposit were extensive and extraction of the metal presented no difficulties. Examination by officers of the Mines Department and the Geological Survey showed that the deposit was only 4 to 9ft. wide and could only be traced for several chains. A sample collected across the face contained a somewhat lower content of uranium than the first sample. The lode is worth driving on, for at depth, where the rock is less oxidised the uranium content may be higher. The find was important in that it gave a lead on the type of country that is well worth prospecting.

A find of radioactive mineral in the Haast Valley below Square Top was announced by Mr P. Corcoran. Analysis of a sample from a boulder showed that the mineral contained a fairly low content of thorium. A survey of the area in company with Mr Corcoran failed to find the outcrop from which the boulder came. More prospecting is warranted in the Haast Valley.

The uranium in the Hawks Crag breccia is so finely distributed that attempts, both in New Zealand and Great Britain, to separate the mineral have proved unsuccessful. The radioactivity appears to be localised in the ferruginous matrix, and possibly the uranium is present not as a distinct mineral but as a fine dissemination of adsorbed material. Further study, both in the field and laboratory, is required to ascertain the nature and source of the uranium; such a study may point to a primary uranium mineral at depth.

Thorium radioactivity in rocks from the Haast River area is due to the presence in the migmatite (gneiss) rock of thorite (thorium silicate). No uranium minerals were found.

GEOTHERMAL INVESTIGATIONS

There has been an intensification of geological work on problems of structural control and distribution of geothermal steam. A new approach to the problem of steam occurrence and accumulation has resulted in a concept of fault control. This concept has to some degree been sustained by successful well siting.

During the year drilling in the Wairakei geothermal area has passed beyond the exploratory stage and entered the stage of intensive production. This was a natural development, somewhat accelerated by the introduction of higher-power, deeper-range, T 12 drilling machines, and by the development of a new geological technique for the siting of high-producing steam wells. During the previous two years six deep wells had been drilled by a T 12 machine to depths ranging from 500 ft. below sea level to almost 2,000 ft. below. Three of these wells (18, 19, and 25) had been drilled through the porous pumice breccia section into dense, almost impermeable ignimbrite, and had proved relatively poor steam producers. The other three wells (24, 26, and 20) were more fortunately sited, and had been drilled into open fissures carrying water and steam at high pressure. These wells were opened and produced more energy than all the other wells in the field.

Air photographic interpretation has played no small part in delineating the active fault pattern of the Wairakei area. The area is one where active faults revealed by recent erosion are known to occur grouped in patterns. The photo-interpretation techniques used were those developed during the air-photo study of Quaternary tectonics.

Geological interpretation of this drilling was advanced notably by the discovery that the three high-producing deep wells were located between 100 and 150 ft. north-west of active north-east-trending fault traces prominent on air photos. The three low-producing deep wells were located differently with respect to fault traces, either south-east of the nearest trace or at distances greater than 150 ft. or less than 100 ft. It seemed a likely assumption that the fault traces were the outcrops of steep, fractured zones extending to considerable depth, and that the high-producing wells had been drilled on the down-dip side of these fractures and had intersected the fractures at depth. The dips of the fractures were determined from the depths of intersection and from the distances between well heads and the fault traces on the surface. These dips were found to range from 84° to 88°, so that precise location of drilling sites seemed essential to tap these fractures at depth. Two wells (28 and 22) were sited to test this theory, and both intersected open fissured country within the depth ranges predicted. Both wells have since been opened and have proved satisfactory steam producers. Two T 12 drilling machines operated by Ministry of Works are now exploiting these fractures and wells have been sited to keep these machines busy till the end of 1956.

Geothermal Chemistry—The main project has been the determination of the volume and nature of the gases coming from geothermal bores at Wairakei. This information is immediately required by engineers designing plant for the utilisation of the steam, and is also a basis for opinions on the probable duration of the supply of steam. The work is difficult and hazardous, and has called for much initiative and ingenuity in the

design of suitable sampling equipment. Determinations have also been made of various constituents of the bore waters, the ratios of which may be a guide to the origin of the waters and steam.

The waters contain lithium to the extent of about fifteen parts per million, and the annual value of the lithium contained in the water used in a 40,000 kW. power station would be about £1,000,000. Investigations at the Dominion Laboratory showed that the lithium could be extracted by ion-exchange methods, but the economics of such a procedure on a commercial scale would need careful investigation.

Physics of the Thermal Area—The programme of routine measurements of natural thermal activity (heat discharge from hot springs, geyser periodicity, etc.) has been extended to new areas, including Waiotapu and Orakei Korako. The work at Waiotapu is supplying valuable data concerning the normal behaviour of a large thermal area as yet undisturbed by drilling operations, and will be of further value in showing the true effects of exploitation as the proposed Waiotapu drilling programme develops. Orakei Korako has been the subject of intensive study over the past year and the establishment of routine measurements here will be on an especially sound basis.

Thirteen new 100 ft. thermocouple chains have been installed at Wairakei (six) and Waiotapu (seven), with the assistance of Ministry of Works and Geophysics Section drilling rigs, making a total of twenty stations that are measured once per month. At Wairakei these thermocouple chains are already proving of value in showing the temperature trends associated with development drilling.

Surface Temperature and Temperature Gradient Survey—So far much of the time has been devoted to developing and testing the method and to evolving efficient field routines for a rapid preliminary survey. Actual surveys have been made along a short line in the Wairakei area to assist with the siting of a deep drill hole, and to investigate correlation between hot areas and local faults in the Parakai hot-spring area near Helensville. The work in the latter area has shown that a good thermal map of even this relatively cool area can be made by a small party in a few days, and that there is a very good correlation between the observed surface-temperature gradients and the temperature of the water obtained from wells in the area. The drilling and measuring equipment is now in a form where efficient surveys can be done on a routine basis, though some further refinements will be introduced as the work proceeds and materials become available.

Geysers and Hot Springs—Field work for the year has been concentrated in the Orakei Korako area. The heat output has been measured and it has been found that Orakei Korako is comparable with Wairakei in terms of natural heat output. Since the area is to be partially submerged in a few years, attempts are being made to formulate a theory of natural thermal activity which will allow a forecast to be made of the future of the natural heat flow.

Theoretical studies of the recovery time for ground temperatures surrounding a borehole that has been closed after a period of discharge, and of the effect of convection within the casing on measured temperature have been made.

Fluid Dynamics—A mixed flow test rig for air and water was put into operation at Dominion Physical Laboratory at the beginning of the year and has been used to investigate the behaviour of various types of

steam-water separator, including U-bend and T types. The results have been of considerable value in developing improved plant for large-scale steam-water separation at Wairakei. The equipment has also been used to study the performance of sampling nozzle and Pitot heads in air-water flows.

In the course of the year the temperature data from Wairakei drill holes have been assembled and used to make a series of isothermal charts of the region. These charts have given an informative picture of underground conditions, and have also been used to provide an improved estimate of stored heat.

Radioactivity in the Thermal Areas—A number of projects using radioactivity principles have been developed to gain scientific information in the Wairakei area. Considerable experience has been gained in such problems as the development of radioactive cement to test grouting procedures; bore output measurements have been made using a β-ray radioactive source; and radioactive well-logging equipment, consisting of a geiger probe and monitoring equipment, has been constructed. This equipment is suitable for well-logging down to 2,000 ft. in bores up to 150° c.

RADIOCARBON DATING

In last year's report the perfection of a new method for aging carbonaceous specimens was announced. The extra sensitivity achieved by this method was tested by experiments designed to explain anomalous results in the aging of carbonaceous specimens other than woods, viz., sea shells and moa and seal bones. These investigations were undertaken to date early New Zealand Moa-hunter periods. The anomalous ages were explained by chemical fractionation processes taking place that enriched or depleted the amount of radiocarbon laid down in the biological mechanisms of shell formation, lime formation, and animal and plant metabolism. Owing to these processes recently-dead animal and recently-dead timber are given dates by ^{14}C measurements that differ by 280 years. Knowing these correction factors, a very accurate picture of the archaeology of New Zealand can be worked out. The work was reported in a paper presented at a conference on ^{14}C aging at Cambridge University. Dr Libby, Chicago Institute of Nuclear Studies, the originator of the method, very favourably commented on this work.

Another investigation was undertaken to test the theory that the industrialisation of the last 70 years accompanied by the production of carbon dioxide from oil and coal should have diluted the activity of atmospheric carbon dioxide. Using trees from both the Northern and Southern Hemispheres, the carbon in 20-year sections was aged back to 300 years. The effect in the Southern Hemisphere has been shown to be the same as that observed for the Northern Hemisphere. This could indicate a rapid exchange of gases between the hemispheres.

The activity of atmospheric carbon dioxide is being examined by a continuous collection of carbon dioxide at the Makara Radio Station. These samples already show that the atmosphere is richer in ^{14}C than contemporary wood. An enrichment in ^{14}C in the atmosphere due to "H" bomb tests is anticipated. These preliminary assays should then prove invaluable.

Sixty specimens have been examined that cover a wide range of significant facts of archaeological and geological interest to New Zealand, as well as Australia and India.

MICROCLIMATOLOGY

From a few feet below the ground to a few tens of feet above the ground is the region in which almost all plant growth takes place, but the climate in this region can differ greatly from place to place and also from day to day. A better knowledge of the microclimate of this layer would be of much help in agricultural work.

Investigations at the Dominion Physical Laboratory are centred on two problems: how the microclimate of a particular location can be specified by a minimum of simple measurements, and how plants react to changes in the microclimate of their surroundings. To carry out the first investigation a station is being built to record all the variations in climate that are likely to have an effect on plant growth. Various plants are being grown in a controlled environment, but under different soil moisture conditions, to find the relation with evapotranspiration (total loss of water from the plant and from the soil by evaporation). The movement of moisture in unsaturated soils has been measured and an electrical analogue constructed to aid in the calculation of the permeabilities of soils. This is being used in relating the uptake of water by roots to the moisture content of the soil.

An instrument for measuring the soil moisture in the ground by means of neutron absorption has been developed. By its use the mean moisture content of the upper six inches of soil can be found without disturbing the soil.

TROPICAL TRANSFORMERS

For several years it has been standard practice overseas to use in difficult situations a type of radio transformer that does not react unfavourably to its climate. It uses grain-oriented steel, is vacuum-impregnated with dry oil, and is sealed into an air-tight tin. Such transformers are not made in New Zealand, and in the last few years a pilot plant has been made and put into commission at the Dominion Physical Laboratory. It is proposed, as soon as it is known to perform satisfactorily, to find a commercial firm to take it over and use it for the benefit of New Zealand in general, and the Department and other Government Departments in particular.

The plant is now being tried on a fairly large batch of transformers to be used in apparatus for the International Geophysical Year.

ELECTRICAL AND RADIO STANDARDS

During the year the New Zealand volt and ohm have been shown to be within the limits of international definition. The Dominion Physical Laboratory is now in a position to calibrate all normal electrical apparatus at D.C. and power frequency, with the exception of instrument transformers, to an accuracy equivalent to that of any overseas laboratory. The necessary equipment for instrument transformers should be here in time to allow for this type of calibration to be done before the end of next year.

Steady progress has been maintained towards equipping the Standards Laboratory to enable tests to be effected with a minimum of non-productive time.

The standard radio frequency station ZLFS was operated through the year on 2·5 mc/s to an accuracy of ± 5 parts in 100 million. Comparisons were made with the National Physical Laboratory frequency standard to an accuracy of a few parts in 1,000 million through a method developed at the Dominion Physical Laboratory for measuring the naval transmitter GBR on 16 kc/s, situated at Rugby, England, and controlled in frequency by the National Physical Laboratory. Measurement of the American station WWVH in Hawaii and GBR were reported in the *Journal of the Institution of Electrical Engineers* and in *Nature* respectively.

The R.F. Bridge Detector, which greatly improves radio-frequency impedance measurements, was completed. The bridge is being used in connection with the R.F. measuring programme, which is of increasing importance to New Zealand. The R.N.Z.A.F. and civil aviation authorities in particular wish to improve their own R.F. measuring techniques and have relied to a large extent on our knowledge in planning their laboratories. The International Geophysical Year Programme is making use of the R.F. measuring techniques, particularly for power and phase.

RADIO WHISTLERS

A programme of observations on very low radio-frequency "whistling" atmospherics was set up. One station was installed by the Dominion Physical Laboratory at Moore's Valley, and another, with the co-operation of the New Zealand Broadcasting Service, at Dunedin. In August 1955, co-operating with United States workers in the Aleutian Islands, important discoveries were made on the propagation of these "whistlers" over long distances, which may have an important bearing on research in the upper atmosphere. A letter to *Nature* on this matter was published on 7 January 1956. The work is continuing.

FOUNDRY SANDS

The original programme of developing a synthetic moulding sand for use in iron foundries has been completed by the Auckland Industrial Development Laboratory. Actual foundry tests have confirmed the suitability of this material. In the course of the investigation sands from a number of deposits have been examined and it is proposed to issue a report covering all these. Particular attention has been paid to those most suited for synthetic moulding sands, and their physical properties over a wide range of clay and water contents have been ascertained. The basic properties of all the moulding sands used in the Auckland foundries have been determined, including a number of sands which are brought from deposits in the South Island. This information will be supplied to the foundries so that they are aware of the range of materials available and how their moulding properties compare.

Selected shell moulding sands have proved successful in trials at two foundries, and other deposits will be investigated shortly so that suitable material will be available from more than one supplier.

FUEL TECHNOLOGY

Steady progress has been made by the Auckland Industrial Development Laboratory in building up the membership and facilities of the Auckland Fuel Users Research Group. The immediate problem has been

to cultivate amongst industrial concerns an appreciation of the value of avoiding wasteful use of fuel and steam. For this reason the work of the group has been, and will be for some time, concentrated on factory problems for its members.

However, a start has been made on two projects of general interest to members of the group as part of the long-term policy of adding to the information available on New Zealand coals. These projects, which are being undertaken in conjunction with the Dominion Laboratory and the Coal Utilisation Committee, deal with the deterioration of coal in storage and the properties of steam coals as supplied to the Auckland user.

THE EFFECT OF THE RUMEN ON DIETARY FAT

From previous work at the Fats Research Laboratory it has become apparent that the rumen micro-organisms play a major role in determining the composition of ruminant fats. During the past year further understanding of the significance of the rumen in fat metabolism has been achieved.

In association with the Grasslands Division it was found that linolenic acid – the main fatty constituent of pasture – on incubation with sheep rumen contents was hydrogenated, forming *trans*-di- and mono-unsaturated acids in addition to considerable proportions of stearic acid. Further work on the di- and mono-unsaturated acids arising from partial hydrogenation of linolenic acid in the rumen has revealed the presence of a diene acid, which differs from those found in vegetable and non-ruminant fats in containing more than one methylenic group between the double bonds. The significance of such acids in nutrition and in oxidative deterioration has yet to be determined.

The rumen has been implicated in connection with the formation of *n*-uneven-numbered and branched-chain acids. The rumen, however, cannot be an essential link in this connection as recent work in this laboratory has revealed the presence of *n-, iso,* and *anteiso* acids of the C_{15} and C_{17} series in shark (*Galeorhinus australis* Macleay) liver oil.

STEAM AND HEAT LOSSES FROM BAKERS' OVENS

Economies in fuel or electric power used for bakers' ovens are likely to result from advances made by the Wheat Research Institute in the understanding of air flow in bakers' ovens. The work began as a study of steam conditions required in ovens for certain types of bread, but it led to the recognition of a major cause of steam and heat losses from ovens and to methods for avoiding them. The work was made possible through the development by the institute of a dew-point instrument for measuring steam concentrations in ovens. In the past no such method had been available, with the result that advances could be made only through baking experiments – a very slow and tedious procedure. With the instrument it is possible to know whether enough steam is present in the oven and to observe from minute to minute the effect on steam concentration of any oven adjustments.

A typical automatic oven may be regarded as a large steel box with a mouth opening 8 ft. wide and 1 ft. high in the front wall and about 3 ft. from the floor. Dough pieces entering such an oven are automatically conveyed upwards from the mouth to the crown of the oven and it is only here, during the first few minutes of baking, that steam can have

any useful effect on the bread. It might have been expected that steam injected at the crown would remain there because of its lightness relative to heated air. Observations with the dew-point instrument have shown, however, that injected steam does not accumulate at the crown but is rapidly lost from the oven. It is now recognised that cold air flows in at the sill of the door opening, is heated within the oven, and passes out at the top of the door. Unfortunately, this flow reaches to the crown above the level of the top of the door and tends to sweep away the steam as fast as it is injected. The quantity of steam that must be injected to reach the desired concentration – about 75 per cent – therefore depends on the rate of air flow; the higher the air flow the more steam must be injected. It became clear from this that the way to reduce steam demand is to reduce the air flow. This has the advantage that it would also reduce the amount of oven heat wasted in heating the flowing air. From this point the investigation turned to an experimental study of the design factors affecting air flow through ovens. Two methods by which air flow can be cut down have been found and other possible methods are to be tested. In the "air door" method a narrow blast of air is blown upwards across the door opening outside the oven. With a small oven this reduced the air flow, and hence steam consumption, by nearly 90 per cent; and a reduction of 75 per cent was achieved on a large oven with only makeshift equipment. The air door could be fitted to most existing ovens, but it has one disadvantage that may yet be overcome. It is, however, already in practical use.

In the other method the mouth of the oven is made in the sole or floor of the oven instead of in the front wall, and experimental evidence suggests that this would eliminate the need to inject steam except at the beginning of baking and that it would also stop convective heat losses. This would be a practicable design for a swing-tray automatic oven.

Another outcome of the finding that steam consumption depends on rate of air flow at the oven crown is a simple method with which it is possible to estimate the size of steam boiler required for any particular oven. Trial and error has been the only method in the past, and several New Zealand bakers have already made costly boiler installations only to find them inadequate.

This work is of considerable importance at the present time for many bakers now face the problems with which it deals.

INFORMATION SERVICE

Information Bureau—The work of the Information Bureau includes the editing and publishing of departmental publications, and the maintenance of the Central Library, Technical Information Section, Public Relations Office, Photographic Section, Translation Section, and Photocopy Service.

The prompt publication of the results of research has again been achieved during the year by regular issues of both sections (Agricultural Research and General Research) of the *New Zealand Journal of Science and Technology*. The number of papers submitted is still steadily increasing, and a high international scientific standard of published papers is maintained. To mark the silver jubilee of the Soil Bureau, the major portion of the November 1955 issue of the *Journal* was devoted to papers on soil science by officers of that bureau.

The staff of the Information Bureau has, during the past twelve months, edited and arranged for the publication of twenty bulletins, memoirs, etc., on behalf of various branches of the Department. Other departmental publications dealt with by the Bureau included the annual report, *The Academic Record of Science Students in the University of New Zealand,* and *Mollusca of the Southern Islands of New Zealand.* The latter publication, Cape Expedition Series, Bulletin No. 15, is the last of this series to be published by the Department; future bulletins in the series will be published by the Dominion Museum. A *D.S.I.R. Newsletter* has been issued each month within the Department with the object of keeping officers up to date on the work of the various branches.

Technical officers from other Government Departments have been using the central library to an increasing extent.

Almost seven hundred important technical inquiries were dealt with by the bureau during the year; most of these were from Government Departments, local authorities, and industrial organisations.

The *Industrial Bulletin,* published jointly with the Department of Industries and Commerce, has included some two hundred and fifty articles and abstracts (mainly extracted from overseas scientific journals) prepared by the bureau. Numerous requests were subsequently received for further information on the subjects referred to.

Press and broadcasting publicity of the work of the Department has shown a marked increase during the year. Additional appreciation has been shown by the press from the increase in the number of special articles it has published on departmental activities.

New work carried out by the Photographic Section included photographing underground drives in the Benneydale coal mine to show variations of contours under pressure, preparation of a cine-film to show the behaviour of a plankton-catching apparatus at different speeds and levels of tow, and the photographing of rookeries in the Christchurch area and of geological features in the Amberley district.

The efficiency of the Photo-copy Service has been increased so that copies can now be made more quickly and at a lower cost than hitherto.

Scientific Liaison Service—The Department's Scientific Liaison Offices in London and Washington maintain direct contact with research organisations overseas, and keep the Department advised of the most recent scientific and technical work being carried out in other countries. The early receipt of this information, much of which would not be available through normal channels, assists the Department and its officers in formulating and modifying research programmes.

The Scientific Liaison Officer in London, in addition to other duties, represents New Zealand on a number of Commonwealth Scientific Committees, and acts in an advisory capacity in scientific matters to the High Commissioner's Office.

In both London and Washington the Department's representatives are associated with liaison officers from other Commonwealth countries in a British Commonwealth Scientific Office (B.C.S.O.). This association has been of considerable benefit to the officers concerned and has been an important factor in facilitating Commonwealth co-operation in scientific matters.

The Department greatly appreciates the assistance given to our staff by overseas research organisations

Commonwealth Agricultural Bureaux—The Commonwealth Agricultural Bureaux (C.A.B.), formerly the Imperial Agricultural Bureaux, is one of the earliest established and one of the most successful organisations on a Commonwealth-wide basis in the field of science. Commonwealth Governments contribute financially to the support of this organisation and world-wide sale of its publications augments its funds.

The principal functions of the C.A.B. are the preparation and publication of abstracts and monographs based on the world's scientific literature in the fields of agriculture and forestry. These and the ancillary services of the organisation enable research and extension workers to keep up to date with the very extensive literature and information on these subjects.

The organisation consists of ten bureaus, three institutes, and a headquarters, all but one of which are located in the United Kingdom.

The quinquennial review conference of the Bureaux was held in London last year. The New Zealand delegates were the Secretary of the Department of Scientific and Industrial Research, the Director of the Extension Division of the Department of Agriculture, and our Scientific Liaison Officer in London.

GRANTS TO OTHER INSTITUTIONS

Apart from the incorporated research associations grants were continued for research in the University (£31,980), and much valuable work is being undertaken. Such grants are closely co-ordinated with those made by the research committee of the University in order to avoid duplication and ensure the most efficient use of the funds available.

The grant (£11,364) to the Cawthron Institute was continued to enable the institute to maintain its wide range of activities in the Nelson area and to undertake specialist chemical research in co-operation with departmental branches, such as the Tobacco and Hop Research Stations. The grant to the Royal Society of New Zealand was maintained at £4,000 to cover increased costs of printing and to assist the society to fulfil its role as the senior scientific society in the Dominion.

CONCLUSION

The Department has continued to receive generous co-operation from other State Departments, the Cawthron Institute and the university colleges, overseas scientific organisations, and from both farming and manufacturing interests. The good relations that have prevailed have been much appreciated and have greatly assisted the promotion of the Department's objectives.

In conclusion, I would thank the staff of the Department for their help and co-operation during the year, and also express my personal indebtedness to the Council of Scientific and Industrial Research and its advisory committees for the assistance they have generously rendered on all occasions.

W. M. Hamilton, Secretary.

BRANCHES

ANIMAL ECOLOGY SECTION

Officer in Charge: Dr K. Wodzicki

PROJECTS UNDER WAY

Research on Rabbits—Reproduction and population structure in relation to environmental factors and control operations; factors controlling the intensity of parasitic infestations; long-term fluctuations in abundance and distribution of rabbits; methods for assessing the density of rabbit populations; age determination in rabbits by the sequence of bone fusion; geographic distribution of rabbit nematodes.

Research on Other Animals—Distribution and ecology of rooks in Canterbury; distribution of rats and their effect on forest regeneration; studies on life history, distribution, dispersal, etc., of magpies, gannets, and blackbirds.

PUBLICATIONS

Effects of Sub-lethal Phosphorus Poisoning on Bone Growth in Wild Rabbits. *N.Z. J. Sci. Tech. B37*:407–15. C. H. Tyndale-Biscoe.

A Study of Natural Mortality in a Wild Population of the Rabbit. *Oryctolagus cuniculus* (L.). *Ibid. B36*:561–80. C. H. Tyndale-Biscoe and R. M. Williams.

The Relationships Between Paunched and Dead Weights of Rabbits. *Ibid. B37*:54–8. J. S. Watson and R. M. Williams.

The Influence of Host Age on Parasitism in Wild Rabbits. *Proc. N.Z. Ecol. Soc. 3*:29–30. P. C. Bull and R. H. Taylor.

The Present Distribution of *Rattus exulans* (Peale) in New Zealand. *N.Z. J. Sci. Tech. B37*:560–70. J. S. Watson.

Observations on the Reproduction and Ecology of the Brush-tailed Possum, *Trichosurus vulpecula* Kerr (Marsupialia), in New Zealand. *Australian J. Zool. 3*:162–84. C. H. Tyndale-Biscoe.

Dispersal of New Zealand Gannets. *Notornis 6*:58–64. P. A. S. Stein and K. Wodzicki.

A Note on the Thermal Resistance of the Feathered Layer of Gannet Skins. *N.Z. J. Sci. Tech. B37*:158–9. M. C. Probine and K. A. Wodzicki.

Ringing Operations, Summary for the Year Ending 31 March 1955. *Notornis 6*:139–42. P. C. Bull (Compilation).

APPLIED MATHEMATICS LABORATORY

Director: Dr R. M. Williams

PROJECTS

Design and Analysis of Experiments—These have been carried out on numerous topics, including fruit research, entomology, use of superphosphate, tobacco research, control of aphids, relation of soil type to dental caries, botanical studies, plant breeding and genetics, effect of particle size in dusts for control of plant diseases and pests, cheese manufacture, and a wide variety of work in grassland research.

Application to Physical Sciences—Analysis of cosmic ray data; determination of the velocity of Fourier components of weather; correlation of geothermal data and rainfall; analysis of soil moisture records to estimate diffusion properties of soil; analysis of properties of clays for hydro-electric earth dam construction; corrosion tests; analysis of microclimatological records, magnetic records, and radio propagation records.

Improvements in Statistical Technique Arising Out of Problems Dealt With by the Laboratory—Methods of curve and periodogram smoothing; developments in non-linear stationary processes, processes involving periodically varying structure, processes generated by linear equations with random coefficients; methods of drawing contours; determination of the significance of differences in ordered series; methods of analysing time replicated data; and new types of experimental design.

Miscellaneous—Survey work on lambing mortalities in the Gisborne area; studies in labour turnover; analysis of experimental data on fat lambs; studies on rabbit populations; statistical ecology; design of experiments for brick industry; effect of joint action of poisons on insects; and construction of tables to simplify inspection of boilers and cranes.

PUBLICATIONS

A Note on the Choice of Sample Volume in a Bacteriological Study of Water. *J. Hygiene 13 (2)*:235–45. J. H. Darwin.

The Mathematical Separation of Plant and Weather Effects in Field Growth Studies. *Aust. J. Agri. Res. 6*:813–22. A. C. Glenday.

Models for Two-dimensional Stationary Processes. *Biometrika 42*:170–78. V. Heine.

Spatial Point Processes with Applications to Ecology. *Ibid. 42*:102–15. H. R. Thompson.

The Outcome of a Stochastic Epidemic. *Ibid. 42*:116–22. P. Whittle.

Some Moment and Distribution Formulae for the Markov Chain. *J. Roy. Stat. Soc. B17*: P. Whittle.

An Investigation of Periodic Fluctuations in the New Zealand Rabbit Population. *N.Z. J. Sci. and Tech. B37*:179–200. P. Whittle.

A Study of the Natural Mortality in a Wild Population of the Rabbit, *Oryctolagus cuniculus* (L). *Ibid. B36*:561–80. C. H. Tyndale-Biscoe and R. M. Williams.

The Relationship Between Paunched and Dead Weights of Rabbits. *Ibid. B37*:54–8. J. S. Watson and R. M. Williams.

Note on the Statistical Estimation of the Experimental Component of Error in Tracer Experiments. *Ibid. B37*:254–57. R. M. Williams.

The Academic Record of Science Students in the University of New Zealand. *N.Z. Dep. sci. industr. Res. Bull. 113*:pp. 64. I. D. Dick, R. M. Williams, and Dermot Straker.

AUCKLAND INDUSTRIAL DEVELOPMENT LABORATORIES

Director: Mr J. B. Brooke

PROJECTS

Medical Instrumentation—Developments of the following: foetal pulse rate recorder; cervical tension indicator; positive/negative pressure breathing apparatus; modified oximeter; automatic premature infant respirator; infant spirometer; calibrated air-oxygen mixer; high-pressure

syringes for angiocardiography; differential pressure recorder for mitral valve; foetal E.C.G. recording; improved cardiotachometer; recording rectal thermometer; sphincter muscle tension recorder; manual pumps for bypassing the heart; improvements to animal breathing valve; displacement transducer for recording movement of the apex of the heart; electrodes for electrocorticography; preliminary work on X-ray isodose recorder; and miniature pressure transducers for internal pressure measurements in bloated cows.

Physics and Electronics—Recording solar integrator; examination of a variety of electrical products for compliance with standard specifications; and construction of electro polishing unit.

Design and Workshop—Negative pressure breathing apparatus; cervical tension indicator; infant respirator; infant spirometer; magazine-wrapping machine; X-ray isodose recorder; swab-making machine; and instruction manual for newspaper-wrapping machine.

Metallurgy—Survey of N.Z. sands and clays for foundry moulding purposes; physical testing to N.Z. or British Standard Specifications; investigations of failed components; non-destructive testing using magnetic or gamma-ray methods; and investigation of some of the chemical and magnetic properties of ilmenite.

Fuel Technology—Regular visits to members' factories; steam surveys; calorific values and moisture content of kraft black liquor, wood waste, and coals; heat transfer problems; checks on combustion problems; failure of a furnace arch; calibration of CO_2 meters for shipping interests; investigations of grit and smoke problems; screen analyses of coals; investigation of comparative running costs of galvanising bath, using various fuels; investigation of trouble experienced with operation of an economic boiler; survey of "as received" coals in Auckland; and storage tests on Kopuku, Kimihia, and Rotowaro coals.

BOTANY DIVISION

Director: Mr C. M. Smith

PROJECTS

Revision of the *Manual of N.Z. Flora;* preparation of flora of adventive plants in New Zealand; preparation of monograph of New Zealand graminaceous plants; preparation of chromosome atlas of New Zealand indigenous plants ((a) report on chromosome behaviour in N.Z. gymnospermous genera, (b) report on chromosome behaviour in N.Z. species of genus *Pomaderris* (Rhamnaceae), and (c) report on chromosome behaviour of N.Z. Violaceae); breeding and ecology of local forms of indigenous species of the genera *Agropyron, Festuca,* and *Danthonia*; ecology of South Island tussock grasslands ((a) vegetational changes in progress at Molesworth, and (b) growth and seasonal habits of species under trial as pasture introductions).

Maintenance and Upkeep of Herbaria: herbarium of indigenous plants, herbarium of adventive and cultivated plants, and seed herbarium; collection and distribution of seeds of indigenous plants and annual issue of an Index Seminum; recording of introductions of seeds from overseas for scientific and commercial purposes; establishment in

Canterbury of a botanic garden for the conduct of the division's observations and experimental work, and for maintenance of a reference collection of growing-plant material; and study of New Zealand freshwater plants and their distribution.

Phormium tenax—The intensive breeding work on *Phormium tenax* has now ceased. Nucleus stocks of the resultant segregated strains secured during the Division's years of this work will be transferred from Bryndwr Gardens to the new sites at Lincoln and will there be maintained as a permanent garden feature.

PUBLICATIONS

The Breeding System of New Zealand Fescue Tussock *Festuca novae-zelandiæ* (Hack.) Cockayne. *N.Z. J. Sci. Tech. A37*:103–05. H. E. Connor and Audrey B. Cook.

A Manual of the Spores of New Zealand Pteridophyta. *Dep. sci. industr. Res. Bull. 116*:186 pp. W. F. Harris.

Notes on the Vegetation and the Flora of Mount Augustus, Buller County. *N.Z. J. Sci. Tech. A37*:175–86. R. Mason and N. T. Moar.

Adventitious Root-shoots of *Dacrydium colensoi* Hook. in Westland, South Island, New Zealand. *Ibid. A37*:207–13. N. T. Moar.

Peat on Mokai-Patea, Ruahine Ranges, North Island, New Zealand. *Ibid. A37*:419–26. N. T. Moar.

Seedling Studies in Fescue-Tussock Grassland. I. *Ibid. A37*:93–9. M. J. A. Simpson and L. B. Moore.

Index Seminum anno MCMLV collectorum: 7 pages. Divisional publication.

CROP RESEARCH DIVISION

Director: Dr E. J. Godley

FIELD-CROP PROJECTS

Wheat—Breeding for the following: a general-purpose wheat of Cross 7 type with higher yields; an early-maturing variety that will not lodge, to replace Tainui in the North Island; a high-yielding wheat with stiff straw and tight chaff for high-fertility land where Dreadnought is grown; a high-quality wheat with higher yields than Hilgendorf; lines of commercial varieties resistant to mildew; and spring wheat suitable for mid-Canterbury.

Wheat Genetics Studies—Inheritance of kernel weight, grain-shattering, protein, mildew-resistance, and purple grain colour.

Wheat Disease Survey—Annual surveys, for five years, of a representative sample of Canterbury wheat crops.

Oat Breeding—Lodging-resistant milling oats; lines of commercial varieties resistant to crown rust; and introduction and testing of promising overseas varieties.

Barley—Work confined to the introduction and testing of new overseas varieties.

Potato Breeding—Resistance to blight (*Phytophthora infestans*), scab, and pink rot (*P. erythroseptica*); resistance to viruses X, Y, and leafroll; and improved agronomic characters.

Virus-free Stocks of Potatoes—Selection of virus-free plants of commercial varieties and maintenance of nucleus stocks; and annual testing of virus-free stocks that are being increased by the Department of Agriculture.

Potato Virus Diseases—Study of the natural spread of virus diseases; study of strains of viruses X and Y; methods of eliminating virus from infected stocks, methods of testing for virus content and virus resistance; study of the nature of resistance and of gene action; and the effect of environment upon resistance.

Potato Blight—Study of blight strains in New Zealand and of their origin; study of the nature of resistance and of gene action; and the effect of environment upon resistance.

Swedes—Breeding for resistance to dry-rot and club-root, and investigation of resistance to aphids.

Rape—Breeding for resistance to aphids by crossing with resistant swedes, and breeding for improved agronomic features in club-root resistant rape.

Lucerne—Breeding for an improved grazing type of lucerne, and for earlier spring and later summer growth.

Lupins—Assembling wild material from other countries to obtain types with large numbers of small seeds, for use in increasing seed production; and breeding a yellow lupin with non-shattering and non-bursting pods with an improved seed yield.

VEGETABLE PROJECTS

Dwarf Beans—Breeding for halo-blight resistance.

Pole Beans—Breeding for rust-resistance; and selection and comparison of strains of the variety Fardenlosa.

Tomatoes—Improvement of fruit shape in Mangere Pale-leaf; a search for resistance to spotted wilt in a promising cross, Pearl Harbour × Rey de los Temperanos; investigations into the production and use of first-generation hybrids in outdoor tomatoes; and investigation into leaf mould in glasshouse tomatoes and possibilities of breeding for immunity.

Savoy Cabbage—The production of uniform strains in varieties Best of All, and Omega.

Spring Cabbage—The development of a uniform strain of the variety Flower of Spring.

Cauliflower—The development of strains of winter cauliflower, with improved yield and uniformity in maturing time.

Peas—The inheritance of immunity to the pea-mosaic virus; transference of mosaic immunity to wilt-resistant Greenfeast; and the effect of the rogue character on seed characters in Onward peas.

Kumara—Formation of a collection of true Maori varieties.

Onions—Selection for white-rot resistance in Pukekohe Long Keeper and study of male sterile strains for use in hybrid onions.

NUCLEUS SEED PRODUCTION

Each year pure seed of some forty crop varieties is produced to provide nucleus seed for the seed certification scheme of the Department of Agriculture.

AGRONOMY PROJECTS

Forage Crop Measurement Techniques—A study of techniques to find less elaborate methods of measuring forage yield and quality than the conventional grazing ones.

Legume - Non-Legume Mixtures—The effect of sowing Broad Red Clover or Crimson Clover with a cereal greenfeed; and measurement of daily live-weight gains, and digestibility, of rape and Borre lupin mixtures.

Foliar Sprays of Urea on Wheat—The effect of rates and times of application on the yield and quality of Cross 7 wheat.

Leaf Rust of Cereal Greenfeeds—The effect of leaf rust on the yield and chemical composition of NIAB ryecorn forage.

NIAB Ryecorn Improvement—Improvement by means of polycross block and progeny testing with selection of the best lines for multiplication and certification.

PLANT PHYSIOLOGY

An investigation of the factors causing abscission of flowers and fruits in yellow lupins, and an investigation of the capacity of various crop plants to utilise available and fixed phosphates in pumice soils.

PLANT BIOCHEMISTRY

Nitrogen Fixation—An investigation of the significance of peptides containing glutamic acid in cultures of *Azotobacter vinelandii.*

Disease Resistance—The significance of the starch nitrogen ratio in the susceptibility of hop varieties to root-rot; the composition of the soluble nitrogen fraction of the leaves from rape and swede varieties that are resistant and susceptible to aphid attack; and a more detailed investigation of the effect of virus infection upon the soluble nitrogenous components of potato tubers.

General Plant Metabolism—The change in metabolic activity of the rape plant with age, especially with respect to the problems of maturity, and insect resistance; the comparative synthesis of proteins in high and low baking quality wheats.

Crop Utilisation—Digestibility trials on single and combined fodders, e.g., rape and lupins; and analyses of feed constituents in Brassicae, greenfeeds, lupins.

PUBLICATIONS

Arawa Wheat. *New Zealand Wheat Review, 1953–1954–1955*:48–50. L. G. Copp.

Hilgendorf Wheat. *Ibid.*:45–7. L. G. Copp and E. W. Hullett.

Details and Results of Trials With Use of Growth Substance Sprays on Outdoor Tomatoes. *New Zealand Commercial Grower, 10 (12)*:4–5. R. M. Davison and W. G. Priestley.

Breeding Systems in New Zealand Plants. I. *Fuchsia. Annals of Botany 19*:549–59. E. J. Godley.

Monoecy and Incompatibility. *Nature, 176*:1176. E. J. Godley.

Fixation of Molecular Nitrogen by Excised Nodules of the Alder. *Acta Chemica Scandinavica 8 (9)*:1730. A. I. Virtanen, T. Moisio, R. M. Allison, and R. H. Burris.

In collaboration with the Wheat Research Institute, the *New Zealand Wheat Review, 1953–1954–1955,* was prepared and published during the year.

DOMINION LABORATORY

Director: Mr F. J. T. Grigg

PROJECTS

Minerals, etc.—Evaluation of uranium ores, West Coast; fractionation of soils by heavy-liquid and magnetic methods; evaluation of sulphur-bearing ores in Thames area; and reversion of superphosphate by fused calcium-magnesium phosphate.

Building Materials, etc.—Concrete: air-entraining agents, fly ash, pozzolanas, light-weight concretes; evaluation of drilling muds; and bloated-clay aggregates for concrete.

Chemical Engineering—Improved pilot plant and commercial plant design for meat dehydration; dehydration of vegetables, fish, and fruit; coal utilisation research; design of separators and investigation of flow of steam and water in pipes in geothermal-steam development; reports on manufacture of calcium magnesium phosphate, and utilisation of ironsands; *Chlorella* in relation to sewage purification; and utilisation of surplus lemons.

Physical Chemistry and Metallurgy—Infra-red spectrography and its application to pesticides, fatty acids, barbiturates, and clays; corrosion by Invercargill water; physical constants of glass; stress corrosion and corrosion fatigue in geothermal investigations; low-temperature embrittlement of steel; and spontaneous combustion of wool.

Organic—Pesticide research on particle size, residues at harvest, and analytical methods. Foaming of water extracts of *Pinus,* and chemistry of wood extractives (taxifolin and aromadendrin) in wood-chemistry research.

Food and Drugs—Examination of foods, drugs, and waters for Department of Health, and bacteriology.

Meat Research—Research on labile muscle factor, connective tissue and toughness of muscle, structural proteins of muscle fibrils and bone taint in meat; dehydration of meat, and storage trials; and investigations on bacon drying and smoking.

Petroleum and Highways Materials—Examination of oils, petrol, bitumens, tars, etc.; investigation of use in New Zealand of multigrade lubricating oils; and research on dyes for use in non-taxable petrol.

Paint—Investigations of paints for exterior woodwork, under-water structures. and metal priming; plastic paints for concrete; and metal protective paints for geothermal projects.

Geothermal Chemistry—Sampling and analysis of Wairakei bores and design of improved apparatus; analysis of geothermal gases; and reports and elaboration of new theories of geothermal phenomena.

Coal—Analysis of coal and collaboration with investigations in chemical-engineering section; and investigations on forms of moisture in coal, and on boron in coal.

PUBLICATIONS

Recommended Methods of Casting Tin Base Bearing Metals into Bearing Shells of Steel, Bronze, Cast Iron, Alloy Steel, and Aluminium. *J. Inst. Automotive & Aeronautical Engineers. 15*:21–23. P. F. Tomalin.

Corrosion of Aircraft Structural Materials by Agricultural Chemicals. *Corrosion 11* (2):44–52. T. Marshall and L. G. Neubauer.

Electric Smelting of Titaniferous Ironsands at Onekaka 1949. *N.Z. J. Sci. Tech. B37*:201–20. T. Marshall and D. Nicholson.

Corrosion of Materials Subjected to Locomotive Smoke and Funnel Blast. *Corrosion 11*:379–382. T. Marshall and R. M. Sinclair.

The Trans-unsaturated Acid Content of Fats of Ruminants and Non-ruminants. *Biochem. J. 61*:603–7. L. Hartman, F. B. Shorland, and I. R. C. McDonald.

Selenium in Apples – the Effect of Applications of Selocide to the Tree and to the Soil. *N.Z. J. Sci. Tech. B37*:119–25. Helen E. Barr, P. J. Clark, and H. Jacks.

Effect of Treatment of Dairy Pastures with BHC and DDT on the Flavour and Composition of Milk, Cream, and Butter. *Ibid. A37*: 146–55. F. H. McDowall, M. R. Patchett, F. Hurst, and J. M. Kelsey.

The Heat from the Wairakei-Taupo Thermal Region Calculated from the Chloride Output. *N.Z. J. Sci. Tech. B36*:622–631. A. J. Ellis and S. H. Wilson.

Geothermal Steam for Power in New Zealand. *Dep. sci. industr. Res. Bull. 117*. S. H. Wilson (Chemical Investigation), T. Marshall (Corrosion Testing).

The Reversion of Superphosphate by Fused Calcium Magnesium Phosphate. *N.Z. J. Sci. Tech. B37*:78–85. J. J. S. Cornes.

Heats of Hydration of New Zealand Portland and Pozzolan Cements. *Ibid. B36*:335–43. R. A. Kennerley.

Stability of Alkaline Solution of Haematin. *Analyst. 80*:562–5. J. F. Scaife.

Variation of Ultimate pH Within Pig Muscles. *J. Sci. & Food Agric. 6*:467–71. J. F. Scaife.

The Connective Tissue Content and Toughness of Sheep Muscles. *Ibid. 7*:51–6. P. M. Nollingham.

A Centrifuge Permitting Continuous Observation of the Spinning Tube. *J. Sci. Instr. 32*:205–6. B. B. Marsh.

A Shipment of Chilled Beef 1952. *N.Z. Dep. sci. industr. Res. Bull. 118*:pp. 79. N. H. Law, N. W. Vere-Jones.

Palatability of Chilled and Frozen Beef. *Food Manufacture, 30*:187–9. N. H. Law.

DOMINION PHYSICAL LABORATORY

Director: Mr W. H. Ward

PROJECTS

Physics of the Thermal Area—A comparison of well-developed and underdeveloped areas by a thermal survey at Wairakei and Waiotapu, and the establishment of routine measurements at Orakei Korako; the explanation of surface thermal relations at Orakei Korako and an estimate of the heat output of the area; a one-week expedition to White Island; the development of a rapid method of preliminary survey, tried at Helensville; and theoretical studies of temperature–time relations near to bore holes.

Heat Research—Investigation of cracking of light-weight concrete flues; general advice on thermal insulation; and investigation of two-phase flow in pipes and separators.

Microclimatology—Establishment of a microclimate recording station; comparison of the measured and estimated evaporation from soils and pastures; elucidation of the thermodynamic and other relations between plant mechanisms and environment; the effect of radiation on plant growth; and development of instruments to measure soil moisture, soil permeability, and the movement of water vapour in the atmosphere.

Isotope Research—Sulphur isotopic survey; radium-D-radon measurements; ^{14}C age measurements; $^{13}C/^{12}C$ variations in nature; ^{14}C variations in nature; carbon isotope exchange rates; radioactive grout and well-logging; nitrogen isotopic measurements; making deuterium mass spectrometer; maintenance and improvements to mass spectrometer; mass spectrometer manual; source of radioactivity in New Zealand soils; high temperature Geiger-Müller tubes; bore output measurements at Wairakei; high temperature nuclear furnace; ionisation levels of carbon dioxide; and correlation of cosmic-ray components with ^{14}C background.

Electron Microscopy—Human dentine (in conjunction with Dental School, Otago University); classification of soil colloids; morphology of *Actinomyces;* motility of spermatozoa; and maintenance and improvements of electron microscope.

Engineering Seismology—Use of analogue computer to evaluate shear stresses in tall buildings; earthquake-stress recorders in a tall building; strong-motion seismographs installed throughout New Zealand to record the characteristics of strong-motion earthquakes; and measurement of rail stresses under dynamic conditions.

Radio Research—The use of a frequency standard in the investigation of long-distance ionospheric propagation; study of sea echo beyond the horizon; application of coherent detection; propagation of centimetre waves almost tangential to a sea surface, and the application of geometrical optics to this project; measurement of ionospheric winds; measurement of radio "whistlers"; development of radar sets for observations of aurorae during the International Geophysical Year; and development of apparatus for observing radio propagation in the Southern Auroral Zone during the International Geophysical Year.

General—Development of an electronic correlator, and the establishment of a prototype plant for making weather-proof transformers.

Optical Design—Simplification of some theory of geometrical optics; development of aspheric lenses; and an experiment related to the general relativity theory.

Standards—Establishment of standards of physical measurement in length, mass, temperature, pressure, photometry, radiation, and air velocity; maintenance of standards of electrical quantities, development of current and voltage transformer testing; develop methods of measurement at radio frequencies; and establish and emit standards of frequency.

PUBLICATIONS

A Simplified Form of Microwave Interferometer for Speed Measurements. *J. Sci. Inst. 32*:354–6. G. W. G. Court.

The Width of Coverage of a Radar Antenna. *I.R.E. Proc. 43*:1016. G. W. G. Court.

Saturable-reactor Frequency Divider. *Wireless Engr. 32*:328–9. G. W. G. Court and C. I. C. Scollay.

Ionospheric Wind Determination from Spaced Radio Receiver Fading Records. *J. Atmos. Terr. Phys. 7*:333–40. G. W. G. Court.

A D.C.-Coupled Circuit Using Voltage Stabilising Valves. *Electronic Engg. 27*:549–50. G. W. G. Court.

Measurement of Wind Force on Various Metal Meshes. *N.Z. Engg. 10*: 218. G. W. G. Court and R. McMillan.

A Harmonic Generator With Tuning Fork Drive. *Electronic Engg. 28*: 13–5. W. A. Penton and G. W. G. Court.

Determination of the Reflection Coefficient of the Sea, for Radar Coverage Calculation, by an Optical Analogy Method. *Inst. El. Engrs. Proc. B.102*:827–30. G. W. G. Court.

A Sine Wave Generator for Very Low Frequencies. *J. Sci. Inst. 32*:282–3 W. A. Penton.

Frequency Variations in New Zealand of 16 Kc/s Transmissions from G.B.R., Rugby. *Nature 177*:179. A. H. Allan, D. D. Crombie, and W. A. Penton.

Doppler Spectrum of Sea Echo at 13·56 Mc/s. *Nature 175*:681-2. D. D. Crombie.

Measurement of the Arrival Angle of "Whistlers". *J. Geophys. Res. 60*: 364–5. D. D. Crombie.

Broadband Transformerless Balanced Modulator. *Rev. Sci. Inst. 26*:985. D. D. Crombie and K. J. Brown.

Integrating Meters for Comparing Light Intensities in Plant Growth Studies. *J. Sci. Inst. 32*:442–4. A. H. Allan and K. J. McCree.

Variations of Received Frequency of WWVH. *I.E.E.J. 1*:650–1. A. H. Allan.

Observations of Whistling Atmospherics at Geomagnetically Conjugate Points. *Nature 177*:30–1. G. McK. Allcock and M. G. Morgan.

An Adiabatic Calorimeter for Control of Mass Curing Chamber. *N.Z. Engg. 11*:86–9. M. C. Probine and E. L. Swales.

A Note on the Thermal Resistance of the Feathered Layer of Gannet Skins. *N.Z. J. Sci. Tech. B37*:158–9. M. C. Probine and K. A. Wodzicki.

A Field Instrument for Measuring the Temperatures of Natural Boiling Pools. *J. Sci. Inst. 32*:261–3. Z. S. Garvitch.

The Construction and Installation of Gypsum Soil Moisture Meters. *N.Z. J. Sci. Tech. B37*:150–7. R. L. Closs and R. L. Jones.

A Thermocouple Anemometer. *J. Sci. Inst. 32*:145–7. R. F. Benseman and H. R. Hart.

A Mechanical Seal for Very High Pressures. *J. Sci. Inst. 32*:446. D. Anson.

A Valve for Regulating Differential Pressures at Small Gas Flows. *J. Sci. Inst. 32*:485–6. D. Anson.

An Electronic Strong-Motion Seismograph. *Seis. Soc. Am. J. 45*:179–86. J. B. C. Taylor and L. W. Harrison.

The Measurement of Stress in Concrete. *N.Z. Engg. 10*:245–60. J. B. C. Taylor and P. T. Evans.

Forced Vibrations of a Body on an Infinite Elastic Solid. *J. App. Mech. 22*:391–400. R. N. Arnold, G. N. Bycroft, and G. B. Warburton.

Forced Vibration of a Rigid Circular Plate on a Semi-infinite Elastic Space and on an Elastic Stratum. *Roy. Soc. Phil. Trans. A248*:327–68. G. N. Bycroft.

Correction for the Effect of Cosmic Radiation on Field Measurements of the Radioactivity of Soils. *N.Z. J. Sci. Tech. B37*:172–8. G. J. McCallum.

The Measurement of Absolute Quantum Efficiencies of Fluorescence. *N.Z. J. Sci. Tech. B37*:142–49. W. H. Melhuish.

The Estimation of the Distribution and Quantity of Water in Two-phase Steam–Water Systems. *N.Z. J. Sci. Tech. B37*:385–95. R. E. Belin and F. B. Knox.

Evaluation of the Accuracy of Radiocarbon Dating Results. *N.Z. J. Sci. Tech. B37*:370–81. G. J. McCallum.

^{14}C Variations in Nature and the Effect on Radiocarbon Dating. *N.Z. J. Sci. Tech. B37*:20–38. T. A. Rafter.

Natural Radioactivity of Soils. *N.Z. J. Sci. Tech. B37*:354–68. H. S. Gibbs and G. J. McCallum.

The Electrical Effects of Tidal Streams in Cook Strait, New Zealand. *Deep-Sea Research 2*:204–12. B. H. Olsson.

Heat Losses from Buildings. Part 3. Reflective Thermal Insulation. *N.Z. Inst. Arch. J. 22*:190–2. L. Bastings.

Heating in the Home. *Home Science Alumnae J. 24*:26–38. L. Bastings.

Note on a Suggested Method for Evaluating Image Sharpness. *Op. Soc. Am. J. 45*:768–9. N. J. Rumsey.

The Effect of Eccentric Loading of Optical Flats During Grinding or Polishing. *J. Sci. Inst. 32*:338–9. N. J. Rumsey.

A Simple Achromatic Doublet for Spectrographic Purposes. *J. Sci. Inst. 32*:403. N. J. Rumsey.

Masses of Light Nuclei. *Phys. Rev. 97*:1004–7. J. E. Drummond.

Masses of Light Nuclei. A Method for Correcting a Table of Masses for New Data. *Phys. Rev. 99*:709–10. J. E. Drummond.

An Approximate Joint Probability Distribution for Wave Amplitude and Frequency in Random Noise. *N.Z. J. Sci. Tech. B36*:537–44. R. A. Wooding.

Approximate Joint Probability Distribution for Wave Amplitude and Frequency in Random Noise. *Nature 176*:564–5. R. A. Wooding.

Clay Mineralogy of N.Z. Soils. Part 1. Electron Micrography. *N.Z. J. Sci. Tech. B37*:314–35. M. Fieldes and K. I. Williamson.

A Bent Crystal X-ray Spectrometer with Roller Bearing Rotation Mechanism. *J. Sci. Inst. 32*:324–5. H. R. Moore.

Influence of Noise on Radar Meteor Observations. *Aust. J. Phys. 8*: 273–8. C. D. Ellyett and G. J. Fraser.

ENTOMOLOGICAL RESEARCH STATION

Director: Dr D. Miller

MAIN PROJECTS

Grass grub and *Oxycanus* investigations (this includes biology and ecology of grass grub); insects associated with *Leptospermum* species; mortality in rata and kamahi; breeding and distribution of egg parasites of green vegetable bug; clover case bearer (*Coleophora* spp.); bibliography of New Zealand entomology; maintenance and development of insect reference collection; systematic catalogue of Coleoptera of New Zealand; identification service and advice concerning control of insect pests; aphis control in cruciferous crops; control of other pests of

crucifers (springtails, three species of weevils, grass-grub beetles and larvae, white butterfly, diamond-back moth, grasshoppers, native crickets, wireworms, and cutworms); biological control of crucifer pests; control of insect and mite pests of agricultural crops in Cook Islands, mainly citrus; systematic work on aphids, scale insects, Melolonthinae and of larval Lepidoptera; study of plant parasitic nematodes; study of insect nutrition; insects concerned with pollination of lucerne (a study of the relative efficiency of pollinating insects and of the significance of other insects in the crops); and apple leaf-curling midge.

OTHER PROJECTS

Virus control of white butterfly; wheat stem weevil control in pastures and seed crops; tussock insect control; control of stored products pests; control of carpet beetles and clothes moths; insect-parasitic nematodes; microbiological control of grass grub; systematics of larval Melolonthinae (Coleoptera); oak leaf-miner (*Lithocolletis messaniella*); housefly and control of other flies by predators; and studies on codling moth and leaf roller in Nelson, carried out in co-operation with the Department of Agriculture (the object of this is to see whether it is practicable to provide a forecasting scheme for the benefit of orchardists).

PUBLICATIONS

Distribution and Control of Springtails in Cruciferous Crops and Pastures. *N.Z. J. Agric. 91* (*1*):13. J. W. Cleland.

New Horticultural Pest Found on Nelson Tobacco. *Ibid. 91* (*4*):349–51. W. Cottier and E. S. Gourlay.

Review of Entomological Research for the Period 1948–54. New Zealand. Reprint, *Sixth Commonwealth Entomological Conference, London,* July 1954. 5 pp. B. B. Given.

A Preliminary Note on the Genus *Pericoptus* (Scarabaeidae, Dynastinae.) *N.Z. Ent. 1* (*5*):15–8. B. B. Given.

Notes on Exotic and New Zealand Insects. *Ibid. 1* (*5*):3–5. E. S. Gourlay.

The Use of Bacteria and Nematodes to Control Insects. *N.Z. Science Review 13*:56–8. J. M. Hoy.

The Final Instar Larva of *Sericospilus cumberi* Given (Scarabaeidae Col.). *N.Z. Ent. 1* (*5*):1–3. J. M. Hoy.

Toxicity of Some Hydrocarbon Insecticides to Earthworms. *N.Z. J. Sci. Tech. A37*:367–72. J. M. Hoy.

Ragwort Seed-fly Establishment in New Zealand. *Ibid. A36*:605–7. J. M. Kelsey.

Control of Grass Grub and Subterranean Caterpillar. *E.R.S. Publication No. 14* (revised). 19 pp. J. M. Kelsey.

Effect of Treatment of Dairy Pastures with BHC and DDT on the Flavour and Composition of Milk, Cream, and Butter. *N.Z. J. Sci. Tech. A37*:146–55. F. H. McDowall, M. R. Patchell, F. Hurst, and J. M. Kelsey.

Control of Grasshoppers Damaging a Field Crop. *N.Z. J. Agric. 92* (*2*): 111–4. A. D. Lowe.

A Note on Secondary Sexual Dimorphism in *Nascioides enysi* (Sharp) (Coleoptera, Buprestidae). *N.Z. Ent. 1* (*5*):14–5. A. M. Stuart.

A Preliminary Account of *Dasyneura mali* Kieffer (Cecidomyidae Dipt.) and an Associated Hymenopterous Parasite in New Zealand. *N.Z. J. Sci. Tech. A37*:462–4. D. H. Todd.

FATS RESEARCH LABORATORY

Director: Dr F. B. Shorland

PROJECTS

General Investigations on the Composition of Animal Fats With Special Reference to Those of Meat and Butter—Isolation and identification of minor constituents: branched-chain fatty acids, unsaturated fatty acids, *trans*-acids, lower fatty acids, and unsaponifiable constituents. Fatty acid composition: the fats of beef and mutton carcasses, etc., and comparison between fatty acid composition of animal fats and those of pasture. Glyceride structure with special reference to butterfat. The use of labelled intermediate to determine the origin of *n*-odd-numbered and branched-chain fatty acids.

The Role of Rumen in Modifying the Dietary Fat—Comparison between the fatty acid composition of pasture fats and those of rumen contents. The effect of rumen cultures on pure unsaturated fatty acids. The nature of the unsaturated fatty acids arising from the hydrogenation in the rumen.

Nutritive Significance of Minor Constituents of Animal Fats—Fatty acid composition of depot fats of rats fed branched-chain fatty acids (in association with the Nutrition Research Department of the Medical Research Council, Dunedin). Effect of fatty constituents on cholesterol deposition.

Nature of Meat Phospholipids—Determination of types of phospholipid constituents and their fatty acid composition.

Industrial Utilisation of Fats—Analysis of tall oil with a view to suggesting possible uses. The relationship between glyceride structure and physical properties of fats.

Rancidity in Fats—The constituents of rancid fat with special reference to those related to odour and off flavour. Measurement of rancidity with thiobarbituric acid and other reagents.

Development of Techniques for Investigation of Fats—Gas-liquid partition and absorption chromatography for the resolution of fatty acid constituents. Estimation of glycerol and monoglycerides.

PUBLICATIONS

The Occurrence of *n*-Undecanoic Acid in Butterfat. *Chem. and Ind. (1955)*:92. R. P. Hansen, F. B. Shorland, and N. J. Cooke.

The Branched-Chain Fatty Acids of Ox Fat: 2. The Isolation of 15-Methylhexadecanoic Acid. *Biochem. J. 61*:141–3. R. P. Hansen, F. B. Shorland, and N. J. Cooke.

The Branched-Chain Fatty Acids of Ox Fat: 3. The Isolation of 14-Methylpentadecanoic Acid (*Iso*palmitic Acid) from Ox Perinephric Fat. *Biochem. J. 61*:547–9. R. P. Hansen, F. B. Shorland, and N. J. Cooke.

The Branched-Chain Fatty Acids of Butterfat: 7. Investigation of the C13 Acids. *Biochem. J. 61*:702–4. F. B. Shorland, T. Gerson, and R. P. Hansen.

The Occurrence of *n*-Nonadecanoic Acid in Ox Perinephric Fat. *Nature 176*:882. R. P. Hansen, F. B. Shorland, and N. J. Cooke.

A Simplified Method of Preparing Pure Mono-, Di-, and Triglycerides, *Nature 176*:1024. L. Hartman.

The Isolation of *n*-Pentadecanoic and *n*-Heptadecanoic Acids from Shark (*Galeorhinus australis* Macleay) Liver Oil. *Biochem. J. 61*:453–6. I. M. Morice and F. B. Shorland.

Isolation of $\triangle^9$ Heptadecenoic Acid from Lamb Caul Fat. *Nature 176*: 737. F. B. Shorland and A. S. Jessop.

The Effect of the Rumen on Dietary Fat. *Nature 175*:1129. F. B. Shorland, R. O. Weenink, and A. T. Johns.

The Trans-unsaturated Acid Contents of Fats of Ruminants and Non-ruminants. *Biochem. J. 61*:603–7. L. Hartman, F. B. Shorland, and I. R. C. McDonald.

Volatile Fatty Acids in Phospholipids. *Nature 176*:882. J. C. Hawke.

Compound Formation in Binary Fatty Acid Mixtures. *Proc. Roy. Soc. A233*:195–202. M. Fieldes and L. Hartman.

Analysis of Technical Monoglycerides with Potassium Periodate. *Analyst 81*:67. L. Hartman.

Note on the Estimation of Periodates in the Presence of Each Other. *N.Z. J. Sci. Tech. B37*:13–14. L. Hartman.

Analysis of Glycerine. *Chem. and Ind. (1955)*:1407–8. L. Hartman.

Formation of Animal Fats (Progress in the Chemistry of Fats and Other Lipids, edited by Holman, Lundberg, and Malkin, Volume 3). *Pergamon Press, London and New York, 1955*:276–326. F. B. Shorland.

A Magnetic Pump for the Laboratory. *J. Sci. Instruments 32*:148. J. G. George.

FRUIT RESEARCH STATION

Director: Mr J. D. Atkinson

PROJECTS

Variety Testing—Trials involving some seven hundred imported apple varieties. Small blocks of promising peach, plum, feijoa, and Chinese gooseberry seedlings. Limited plots of imported apricot, citrus, and minor subtropical fruit varieties.

Rootstock Testing—Long-term trials of selected apple stocks worked with five scion varieties; plum stocks budded with three varieties; citrus stocks grafted with four varieties; and pear stocks worked with one variety. A search for *Phytophthora* resistance in apple stocks is in progress.

Citrus Breeding—Objectives are the production of improved lemons, citrus hybrids suitable for local conditions, and nucellar seedlings of successful citrus varieties free from virus infection.

Strawberry Breeding—Objective is to breed resistance to virus and root rot into a strawberry with the desirable characteristics of the Captain Cook variety.

Fruit Descriptions—Formal description and classification of Japanese-type plums grown in New Zealand.

Application of Hormones to Horticulture—Six-monthly certification lists of commercial hormone preparations; effects of hormones on tomato quality; early ripening of stone fruits; parthenocarpic development of frosted apricots; and pre-harvest drop of grape fruit.

Chemical Thinning—Apples: effect of timing and concentration of sprays, and reactions of treated fruit in cool store; compatability of thinning agents with other sprays; effect on biennial bearing, and studies on cell size of treated fruit. Stone fruit: preliminary attempts to thin apricots and peaches.

Auxin Estimations—Studies on natural auxin occurring in apple sap.

Orchard Management—Effects of grassing down on tree growth and yield; studies of contour planting on rolling country.

Tree Nutrition—Examination of yield, growth, and storage data from long-term apple manurial blocks; with Dominion Laboratory, analysis of leaves from these blocks; effects of heavy topdressing on apple yields; foliar applications of fertilisers; and effect of urea on fruit set.

Tree Metabolism—Identification of nitrogen compounds in apple and other sap and quantitative determination of amino-acids; and changes induced in apple leaves by application of urea.

Apple and Pear Storage—Methods of scald control with emphasis on impregnated wraps; orchard factors affecting storage quality, including fertiliser treatment, chemical thinning, pomological variations within varieties and locality; effects of case liners on wilting in apples and pears; and studies on optimum storage temperatures for apples.

Biochemistry of Apple Fruit—Studies on the biochemical factors affecting storage quality of apples with emphasis on the role of nitrogen.

Virus Diseases—In co-operation with Plant Diseases Division, identification of virus diseases in tree fruits, effects of such diseases on growth and yield, and methods of raising virus-free trees.

Frost—Testing an air-mixing machine for frost control, and measurement of temperatures dangerous to cherries and peaches.

Miscellaneous—Suppression of pear water shoots with maleic hydrazide; sterilisation of tree sites for replanting; and location of healthy budwood trees.

PUBLICATIONS

Frost and Fruitgrowing. *Orchardist of N.Z. 28 (7)*:2, 3, 5. J. D. Atkinson.

Contour Planting on Moutere Hills. *Ibid. 28 (11)*:2, 3, 5, 7. W. J. Biggar and R. C. Dixie.

Certification of Plant Hormones. *Ibid. 28 (6)*:29. E. G. Bollard.

Certification List of Plant Hormones. *N.Z. Com. Grower 11 (8)*:3. E. G. Bollard.

Trace Element Deficiencies of Fruit Crops in New Zealand. *Dep. sci. industr. Res. Bull. 115*:52 pp. E. G. Bollard.

The Use of Chemical Thinning Sprays on Apple Trees in New Zealand. 2. Further Experiments With Dinitro Compounds and Synthetic-Growth Substances. *N.Z. J. Sci. Tech. A37*:1–7. R. M. Davison.

Comparison of Four Rootstocks for Sultan Plum in the Auckland District. *Ibid. A37*:318–22. A. Farmer.

Apple Rootstock Trials. II. Dougherty on East Malling, Merton and Local Rootstocks. *Ibid. A36*:560–70. C. E. Woodhead and D. W. McKenzie.

What is the Future of the Naranjilla in New Zealand? *Orchardist of N.Z. 29 (2)*:2–3. H. M. Mouat.

Dressings for Tree Wounds: Testing of Materials. *Ibid. 28 (7)*:7, 9, 11. C. A. S. Padfield.

Factors Affecting Incidence of Superficial Scald in the Rome Beauty Apple and its Coloured Sport, Frimley Beauty. *N.Z. J. Sci. Tech. A37*:312–7. C. A. S. Padfield.

The Cool Storage and Export of New Zealand Grown Williams' Bon Chrétien Pears. I. The Effect on Keeping Quality of Soil Type, Picking Date, and Delay Between Harvest and Cool Storage. *Ibid. A37 (3)*:229–37. C. A. S. Padfield.

The Cool Storage and Export of New Zealand Grown Williams' Bon Chrétien Pears. II. Ripening After Cool Storage. *Ibid. A37*:238–40. C. A. S. Padfield.

GEOLOGICAL SURVEY

Director: Dr L. I. Grange

REGIONAL PROJECTS

Geological—Surveys on one inch to a mile of subdivisions in National Park, Murchison, South Canterbury, and Southland districts are being continued. The field work in the Amberley (North Canterbury) and Takitimu (Western Southland) subdivisions is complete. Mapping on four mile to an inch was continued in the East Cape area of the North Island aimed at classifying Cretaceous stratigraphy and geological history.

Paleontology—Revision of Jurassic stratigraphy and ammonites of Kawhia Harbour (in collaboration with Dr W. J. Arkell, Sedgwick Museum, Cambridge). Determination of Permian fauna of Southland (at Sedgwick Museum, Cambridge). Microfaunal correlation of Upper Oligocene of Auckland and Waikato.

Petrology—Petrological study of the metamorphic rocks in the Murchison area is nearing completion.

Ground Water—Ground water continues to occupy the attention of district offices, particularly in Auckland, Hawke's Bay, and Canterbury areas.

Coal—Survey of the Waikato coalfield is near completion; diversion of effort to other work has slowed this project.

Four Mile Geological Map—Using data of existing and where necessary additional surveys, the compilation of information for the four-mile geological maps of New Zealand commenced. This stock-taking of geological knowledge is planned to culminate in 1965 with the appearance of a Four Mile Geological Atlas of New Zealand.

SPECIAL PROJECTS

Quaternary Tectonics—Work continues on the mapping of active faults by our photo-interpretation and field mapping. Planned use is being made of the generous collaboration of Civil Aviation Section of Air Department during calibration flights to obtain air photographs, both vertical and obliques, of all the important faults under suitable lighting conditions.

Pleistocene History—Mapping of Pleistocene deposits has continued and elucidation of Pleistocene history using ^{14}C age determinations is continuing. Active studies of this project are being carried out in Southland, Canterbury, Westland, Wellington, Rotorua, and in the Waikato.

Paleontology—Revision of N.Z. belemnites; Cretaceous and Tertiary corals (with co-operation of Cornell University, New York, U.S.A.) and New Zealand Cretaceous *Inoceramus*. Monograph and revision of Foraminifera of Oligocene stages.

Geological Map of New Zealand—A new geological map of New Zealand on 1: 2,000,000 has been prepared, and publication is proposed in the coming year. A simpler version of the map, together with a short descriptive note, will appear in the proposed National Atlas, and at the same time the preparation of a new mineral map is proceeding.

INDUSTRIAL AND ROUTINE PROJECTS

Foundation Problems—Foundations of dams and bridges continue to claim considerable attention. Most work of this nature has been in Auckland and Otago districts. An increasing demand is being made on the Survey for systematic geological studies of road-metal aggregate sources.

Coal Mines—Advice to mine operators in the principal coalfields of New Zealand continues as an important follow-up of regional work in the coalfields.

Agriculture Minerals—Limestone deposits were examined in all parts of the country. Serpentine deposits at D'Urville Island have been revisited in view of likely future development.

Geothermal—The geological aspect of the study and development of geothermal steam for power has been pushed on vigorously. Field studies supplemented by valuable air photographic interpretation have together given a clearer structural picture. Petrological studies of the hydrothermal alteration of the rock proceeds.

Uranium—Encouragement to prospectors by way of advice and testing of samples has continued, and a steady flow of samples continues to be received. Field and mineralogical studies of the recent finds are planned with a view to understanding the mineralisation of these occurrences.

PUBLICATIONS

Fluctuations of Ground Water Levels in New Zealand and Their Significance. *Proc. Internat. Association of Hydrology* 2:25–31. B. W. Collins.

The Occurrence and Utilisation of Ground Water in New Zealand. *Proc. Internat. Association of Hydrology* 2:295–307. B. W. Collins.

Gravity Survey for Possible Oil Structures, Kotuku-Ahaura District, North Westland. *N.Z. J. Sci. Tech. B37*:571–86. R. R. Dibble and R. P. Suggate.

Kapitean (Upper Miocene) Mollusca from Te Waewae Bay, Southland, New Zealand. *Trans. Roy. Soc. N.Z. 82*:1049–59. C. A. Fleming.

Ecology of the Subantarctic Islands. Geological History. *Proc. N.Z. Ecol. Soc. 2*:2 pp. C. A. Fleming.

Quaternary Geochronology in New Zealand. *Proc. of IV Internat. Congress of the Quaternary, 3–8*. C. A. Fleming.

Geothermal Steam for Power in New Zealand. *N.Z. Dep. sci. industr. Res. Bull. 117*:192 pp. Compiled by L. I. Grange; Geology and Geophysics, A. C. Beck and E. I. Robertson; Hydrothermal Rock Alteration, A. Steiner.

Geology of the Naseby District. *N.Z. J. Sci. Tech. B36*:581–99. H. J. Harrington.

Present Status of Micropaleontology. *N.Z. Sci. Rev. 13*:41–52. N. de B. Hornibrook.

Ostracoda in the Deposits of Pyramid Valley Swamp. *Rec. Cant. Mus. 6*: 267–78. N. de B. Hornibrook.

Mesozoic and Lower Tertiary Stratigraphy and Limestone Deposits, Torehina, Coromandel. *N.Z. J. Sci. Tech. B37*:107–14. David Kear.

Stranded Moraines of the Hooker and Mueller Glaciers. *Ibid. B37*:221–3. I. C. McKellar.

Methods of Distinguishing Sea-ground-water from Hydrothermal Water. *Ibid. B37*:597–602. J. C. Schofield.

Wairakite, the Calcium Analogue of Analcime, a New Zeolite Mineral. *Min. Mag. 30*:591–698. A. Steiner.

Puponga Coalfield. *N.Z. J. Sci. Tech. B37*:539–59. R. P. Suggate.

Deep Drilling for Coal – Brunner - Mount Davy Block, Greymouth Coalfield, New Zealand. *Ibid. 37*:86–105. R. P. Suggate.

An Isoclinal Fold on Hackel Peak, Southern Alps, New Zealand. S79. *Trans. Roy. Soc. N.Z. 83*:345–6. J. B. Waterhouse.

Recent French Contributions to the Geology of New Caledonia. *N.Z. J. Sci. Tech. B37*:587–96. J. B. Waterhouse.

A Revision of the Type Clarentian Section at Coverham, Clarence Valley. S35. *Trans. Roy. Soc. N.Z. 83*:93–118. H. W. Wellman.

New Zealand Quaternary Tectonics. *Geologischen Randschau 43*:248–57. H. W. Wellman.

The Geology Between Bruce Bay and Haast River, South Westland. *N.Z. Geol. Surv. Bull. n.s. 48*:46. H. W. Wellman.

Pleistocene and Recent Deposits of New Zealand. *Trans. Roy. Soc. N.Z. 82*: 909–12. H. W. Wellman.

Report on British Volcanological Research During the Period September 1939 to March 1954. Part 3. British Commonwealth *Vol. Bull. I.U.G.G. 26*:35–142. R. W. Willett.

The Northern Continuation of the Canterbury Plains, Canterbury, New Zealand. *N.Z. J. Sci. Tech. B37*:126–31. D. D. Wilson.

Note on the Geology of the Ant Stream Tertiary Outlier, North Canterbury, New Zealand. *Ibid. B37*:603–5. D. D. Wilson.

The Late Cretaceous and Early Tertiary Transgression in South Island, New Zealand. *Ibid. B37*:610–22. D. D. Wilson.

The Genus *Baryspira* (Mollusca) in New Zealand. *D.S.I.R. paleon. Bull. 24*:48 pp. O. P. Olson.

GEOPHYSICS DIVISION

Director: Dr E. I. Robertson

PROJECTS

Apia Observatory—Continuous recording and analysis of earthquake data; continuous recording and analysis of the geomagnetic field; and installation of modern magnetic instruments.

Magnetic Survey—Continuous recording and analysis of the geomagnetic field at Amberley; study of secular variation and preparation of magnetic charts for the south-west Pacific area; and completion of fluxgate magnetometers for use in ionosphere and volcanological research.

Geophysical Observatory—Continuous recording and analysis of ionospheric conditions at Christchurch, Rarotonga, and Campbell Island; completion of installation of automatic ionospheric equipment at Rarotonga; assistance to Canterbury College Industrial Development Department with construction of panoramic ionosondes; the determination of

electron distribution with height; geomagnetic sudden commencements; east-west asymmetry in the cosmic ray intensity at Christchurch; continuous recording and analysis of cosmic ray intensity at Christchurch; investigation of F. 2 characteristics at the magnetically conjugate stations of Maui and Rarotonga; and construction of a meson telescope for installation at Invercargill for the International Geophysical Year.

Seismological Observatory—Continuous recording and analysis of earthquake data; provision of New Zealand time service; crustal structure of the New Zealand region; strain-release characteristics of aftershocks, earthquake swarms, and historical New Zealand earthquakes; seismic travel-times in the New Zealand region; transfer of Christchurch seismographs to Gebbies Pass and to Roxburgh Hydro; installation of Benioff seismographs at Samoa and Scott Base in the Ross Sea Dependency; establishment of a seismological station at Raoul Island, Kermadecs; and latitude and longitude programme for the International Geophysical Year.

N.Z. Oceanographic Institute—Physical Oceanography: Seasonal variations in inshore circulation systems; wind generation of waves; relation of surface currents to local winds; development of plummet method for density determination; and study of tides of large embayments with particular reference to Cook Strait. Marine Biology: Distribution and behaviour of fouling organisms; and relation of microdistribution of plankton to environment. Marine Geology: Distribution of recent sediments off the east coast, North Island; and structure and morphology of Cook Strait.

Geophysical Survey—Geophysical surveys of the Taranaki and Greymouth oil areas; bridge foundation investigations; convergence measurements in coal mines related to safety and economy of mining; paleomagnetism of volcanic and sedimentary rocks in N.Z.; gravity surveys; fundamental studies of volcanological phenomena; major geological structure of the South Island, and seismic survey of Cook Strait area.

PUBLICATIONS

A Coal Seam as a Guide for Seismic Energy. *Nature, 176*:1224. F. F. Evison.

Earthquakes in N.Z. During the Year 1953. *Seis. Obs. (Bull. S99)*. R. C. Hayes.

The Seismicity of Auckland City and Northland. *N.Z. J. Sci. Tech. B36*: 488–94. G. A. Eiby.

The Direction of Fault Movement in New Zealand. *Ibid. B36*:552–6. G. A. Eiby.

Note on the Automatic Recording of Time Signals on Seismograph Records. *Ibid. B37*:115–8. B. H. Olsson.

Gravity Survey for Possible Oil Structures, Kotoku-Ahaura District, North Westland. *Ibid. B37*:571–86. R. R. Dibble and R. P. Suggate.

Aeromagnetic Surveys in New Zealand. 1949–52. *Dep. sci. industr. Geophysical Memoir No. 3*. V. B. Gerard and J. A. Lawrie.

An Approximate Joint Probability Distribution for Wave Amplitude and Frequency in Random Noise. *N.Z. J. Sci. Tech. B36*:537–44. R. A. Wooding.

Sedimentation in Lyttelton Harbour, South Island, New Zealand. *Ibid. B36*:603–21. J. W. Brodie.

Some Hydrological Features of the Tropical South-west Pacific Ocean. *Ibid. B37*:39–46. D. M. Garner.
A Note on Tidal Circulation in Lyttelton Harbour. *Ibid. B37*:47–53. D. M. Garner and N. M. Ridgway.
Littoral Zonation in Two Caves in the Auckland District. *Trans. Roy. Soc. N.Z. 83*:321–31 U. V. Dellow and R. M. Cassie.
Bibliography of New Zealand Oceanography. 1949–53. *Dep. sci. industr. Geophysical Memoir No. 4*. J. W. Brodie.
Amberley Observatory, *Magnetic Results for 1953*.
Quarterly Seismic Bulletins, E128 to E132.
A Simple, Sensitive, Saturated-core Magnetometer. *J. Sci. Instruments, 32*:164–6. V. B. Gerard.

GRASSLANDS DIVISION

Acting Director: Mr E. O. C. Hyde

PROJECTS

Pasture Establishment—Oversowing of grasses and clovers in established pastures; pre- and post-emergence use of hormone on pumice soils; longevity of buried seed populations under pasture and fallow.

Pasture Management of Lowland Country—Comparison of farming systems for fat-lamb production; a study of the factors involved in maximum butterfat per acre production (in collaboration with Massey Agricultural College); grazing intensity and survival of short-rotation ryegrass in the autumn; fertiliser trials – the effect of phosphorus, sulphur, lime, and molybdenum on pasture growth; interaction of water and nitrogen on pasture growth in summer, grazing intensity and times of grazing in relation to total production and composition of pasture; and the rate of growth of various pasture mixtures defoliated at different levels throughout the year.

Pasture Management of Hill Country—Pre- and post-sowing management for establishment of oversown clovers and *Lotus;* methods for thickening up sparse clover stands; rotational grazing versus set stocking of hill country pastures and the provision of winter and summer feed; studies on the differential management of sunny and shady slopes; studies in re-seeding of subterranean clover under different management; and dormant clover seed in hill-country soils and its ecological implications.

Plant Physiology—Influence of environment and of defoliation on the growth patterns of major pasture species; the influence of different temperature levels on the growth of pasture species under controlled environments; phosphate uptake by excised roots of grasses and wheat; the effect of the "apparent free space" in roots and its significance in transport of nutrients; the terminal oxidase system in roots; and influence of changes in light and temperature on grass root morphology.

Soil Fertility—Rate of increase or decrease of soil fertility under different crops and pastures; and organic matter and available plant nutrients in pumice soils.

Ensilage—The use of sodium metabisulphite in pasture silage; the effect on total production of early and late cutting for silage or hay.

Plant Chemistry—Studies on the field treatment of bloat by pasture spraying; laboratory studies on the constituents of red clover likely to contribute to foam stability in the rumen; rumen studies to determine

conditions for maximum foaming and the reason for animal differences; cytoplasmic proteins of pasture species and the pattern of synthesis of soluble constituents under different environmental conditions; and investigations on the possible goitrogenic factors in white clover and the iodine level of various pasture species.

Plant Breeding and Genetics—The maintenance and improvement of bred strains of pasture plants already in commerce under certification; the selection and breeding of strains of *Lotus;* trials of bred strains of zigzag clover in South Island tussock country; strain investigations in strawberry clover; the breeding of a new ryegrass with characters intermediate between those of perennial ryegrass and short-rotation ryegrass; the production and study of polyploids in red clover and *Lotus;* hybridisation of *Lolium* and *Festuca* to determine whether the desirable features of each genus can be combined in one plant; the production of a white clover strain that breeds true for an easily identifiable leaf marking; the production genetics of ryegrasses; genetic studies with white clover; studies to ascertain whether genetic differences exist between plants in their ability to grow at different levels of mineral nutrients, and their ability to absorb mineral nutrients; the reactions of red clover to photoperiod; and experiments on techniques with the aim of improving certification procedures.

PUBLICATIONS

Effects of Defoliation and Shading on Short-rotation Ryegrass. *N.Z. J. Sci. Tech. A36*:586–604. K. J. Mitchell and S. T. J. Coles.

The Effect on an Establishing Pasture of Spraying With Sodium 2-methyl - 4 - chlorophenoxyacetate. *Ibid. A36*:548–56. D. B. Edmond.

Growth of Pasture Species. II. Perennial Ryegrass (*Lolium perenne*), Cocksfoot (*Dactylis glomerata*) and Paspalum (*Paspalum dilatatum*). *Ibid. A37*:8–26. K. J. Mitchell.

Effect of Photoperiod on Varieties of Red Clover (*Trifolium pratense* L.). *Ibid. A37*:40–54. L. W. Gorman.

Methods for Determining the Viability of Various Seeds by Tetrazolium Staining. III. Italian Ryegrass and Short-rotation Ryegrass. *Ibid. A37*:36–9. E. O. C. Hyde.

An Aerial Survey of Ascospore Distribution of Blind-seed Disease of Ryegrass (*Gloeotinia (Phialea) temulenta*). *Ibid. A37*:106–9. J. C. Neill and C. S. Armstrong.

Pasture Establishment on Pumice Soils. *Ibid. A37*:110–40. P. D. Sears, E. O. C. Hyde, and R. M. Greenwood.

Pasture Quality and Ruminant Digestion.

I. Seasonal Change in Botanical and Chemical Composition of Pasture. *Ibid. A37*:301–11. A. T. Johns.

II. Levels of Volatile Acids and Ammonia in the Rumen of Sheep on a High-production Pasture. *Ibid. A37*:323–31. A. T. Johns.

Growth of Pasture Species. III. White Clover (*Trifolium repens*), Subterranean Clover (*T. subterraneum*) and Lotus Major (*L. uliginosus*). *Ibid. A37*:395–413. K. J. Mitchell.

Seed Production Studies. *Ibid.* J. P. Lambert.

I. The Effect of Nitrogenous Fertiliser, Applied at Different Rates and Dates, on Seed Production in Cocksfoot (*Dactylis glomerata* L.). *A37*:432–42.

II. The Effect of Grazing on Seed Production in Cocksfoot (*Dactylis glomerata* L.). *A37*:443–50.

A Study in Rate of Pasture Growth. *Aust. J. Agric. Res. 6*:804–12. R. W. Brougham.

Genotype – Environment Interactions in *Lolium perenne* L. *Nature 175*:944. S. O. Fejer.

The Function of Pedigree Strains of Pasture Plants. *Proc. 16th Conf. N.Z. Grassl. Ass.* 67–74. L. Corkill.

The Effect of Changes in Environment and Management on Growth of Pasture Species. *Ibid.* 75–81. K. J. Mitchell.

The Value of Pasture Species in Otago and Southland. *Ibid.* 122–31. J. P. Lambert.

A Comparison Between New Zealand and Imported Strains of Cocksfoot. *Ibid.* 200–6. L. W. Gorman.

The Selective Spraying of Herbicides. *Proc. 8th N.Z. Weed Control Conf.* 92–5.

The Agricultural Potential of South America. A New Zealander Looks at Argentina, Uruguay, and Chile. *Proc. 18th Ann. Mtg. Sheepfrms. Massey Agric. Coll.* 17–21. P. D. Sears.

Red Clover Bloat Control. Results of Pasture Spraying. *Ibid.* 84–9. C. S. W. Reid.

Set Stocking *v.* Rotational Grazing of Sheep on Hill Country. Systems Compared on Highly Improved Pastures. *Ibid.* 165–75. F. E. T. Suckling.

Symposium on Feeding the Milking Herd in a Dry Summer (d) Pasture as Summer Feed for the Dairy Cow. *Proc. 8th Ann. Mtg. Dairyfrms., Massey Agric. Coll.* 65–9. L. Corkill.

What's New? *Ibid.*

(b) The Use of Sodium Bisulphite for Silage Making. 115–19. P. D. Sears.

(c) Inoculation of Clover Seed. 119–23. J. Melville.

(d) Work on Bloat Control at Grasslands. 123–25. C. S. W. Reid.

Bloat Can Now be Controlled. *N.Z. Dairy Exporter 31*:51–7. P. D. Sears and C. S. W. Reid.

Pasture Improvement in Relation to Animal Health and Production. *N.Z. Vet. J. 3*:86–90. J. Melville.

HOP RESEARCH

Station Research Officer: Dr R. H. J. Roborgh

PROJECTS

Breeding—The study of botanical characters to aid differentiation of hop varieties; the introduction and evaluation of hop varieties from overseas; the breeding of new hop varieties resistant to root rot (*Phytophthora* sp.); the germination of hop seed; the technique of testing for susceptibility to root rot at the seedling stage; the technique of rapid propagation of promising seedlings; and the raising of polyploids.

Agricultural Operations—Wiring the hop garden at different heights; spacing of hop hills; cultivation and covercropping on different soil types; manuring particularly as regards influence on the occurrence of root rot; pruning at different times throughout the year; the evaluation of different stringing methods; training different types of vines; picking by hand with and without cutting the vines; and drying conditions.

PUBLICATION

Influence of Organic Manures on Occurrence of Black Root Rot in Hops. *N.Z. J. Agri.* 92:160. R. H. J. Roborgh.

INFORMATION BUREAU

Officer in Charge: Mr N. A. Marris

PROJECTS

The Information Bureau is responsible for the editing and publishing of the *New Zealand Journal of Science and Technology* and other departmental publications. The bureau also provides central library services, which include reference facilities, inter-library lending, and book orderings; a technical information section; a public relations and publicity section; a translation section; a photographic section; and a photo-copy service. A *D.S.I.R. Newsletter* is issued each month for staff information. A third edition of the departmental handbook has been planned. A series of training lectures were given to central and branch library staff.

PUBLICATIONS

In addition to the *Journal,* twenty bulletins, memoirs, etc., were edited and published by the Information Bureau. Bulletins published, but not shown in the separate lists of publications of the individual branches, included the following:

Annual Report.

The Academic Record of Science Students in the University of New Zealand.

Cape Expedition Series Bulletin No. 15: Mollusca of the Southern Islands of New Zealand.

PLANT DISEASES DIVISION

Director: Dr G. H. Cunningham

PROJECTS

Entomology

Physiological effects of DDT on insects; control of Australian carpet beetles; control of timber insects, especially existing infestation; taxonomy of *Acalyptera* (Diptera); resistance of plants to insect attack, especially aphids on swedes and rape; survey of leaf rollers on citrus and their adult and larval taxonomy.

Economic Mycology

Testing French-bean breeding material for resistance to rust (co-operative project with Crop Research Division); studies on cause of death of *Pinus radiata* trees; prevention and control of silver leaf (*Stereum purpureum*) disease of stone fruits; race determination and breeding for resistance to tomato leaf mould (*Cladosporium fulvum*) (joint project with Crop Research Division); soil treatments with soluble fungicides for control of soil fungi; and host range studies with verticillium wilt (*Verticillium dahliae*).

Wheat Diseases: the wheat disease survey is being continued and the following diseases studied – powdery mildew (*Erysiphe graminis*), speckled leaf and stem blotch (*Septoria tritici*), leaf rust (*Puccinia elmi*), pythium root rot (*Pythium debaryanum*) crown rot (*Fusarium culmorum* and *Rhizoctoria solani*) and cereal yellow dwarf (in co-operation with Crop Research Division).

Oat Diseases: race studies of the crown rust fungus (*Puccinia coronata* v. *avenae*); brassica diseases; studies on dry rot (*Phoma lingham*) and club root (*Plasmodiophora brassicae*) (co-operative project with Department of Agriculture, Lincoln College, and Crop Research Division); linseed diseases; classification of flax rust (*Melampsora lini*) races; ryegrass diseases; and studies on crown rust (*Puccinia coronata* v. *lolii*) (in collaboration with Grasslands Division and the Department of Agriculture).

Seed Pathology: determination of *Ascochyta* spp. in lines of pea seed.

Diseases caused by *Phytophthora:* studies on collar rot and crown rot of apples (*Phytophthora cactorum*), black rot of hops (*P. cactorum* v. *applanata*), black shank of tobacco (*P. parasitica*), pink rot of potato (*P. erythoseptica*), black pod of cacao (*P. palmivora*), and red core root rot of strawberries (*P. fragariae*).

Soil-borne Diseases: studies on white rot of onions (*Sclerotinia cepivorum*) (in collaboration with Department of Agriculture), and verticillium wilt of tobacco and tomato (in collaboration with Tobacco Research Station).

Leaf and Stem Diseases: Studies on stem rot (*Ascochyta pisi*) of lupins and black stem of lucerne (*Ascochyta imperfecta*).

Systematic Mycology

Collection and identification of New Zealand fungi for herbarium; preparation of monographs on genera of the Thelephoraceae; taxonomic and life-history studies of New Zealand Hypocreaceae; and description of further species of Uredinales and Ustilaginales recorded in New Zealand.

Bacteriology and Microbiology

Blast of Stone Fruit (*Pseudomonas syringae*): studies on strains and strain variations, factors favouring infection, and effect of defoliation chemicals on susceptibility of peach trees and on field control in nurseries and orchards using streptomycin and bordeaux mixture; blossom blast of pear (*Pseudomonas syringae*) - studies on control in the field; bacterial spot of plum and peach (*Xanthomonas pruni*) – investigations on control by use of resistant stocks and by therapeutant sprays; fireblight (*Erwinia amylovora*), taxonomic and strain variation studies and investigations on field control.

Taxonomic studies of the causal organisms of oleander knot, bacterial wilt of tomato, leaf spot of poinsettia and halo blight of oats; preliminary study of taxonomic methods for plant bacteria; and taxonomic studies of common pathogenic bacteria.

Maintenance of certification scheme for legume seed inoculants; glasshouse and field tests with selected strains of *Rhizobium* from New Zealand, Australia, and other overseas countries; studies on effect of molybdenum on efficiency of nodule bacteria; and selection, isolation, and testing strains of nodule bacteria in an attempt to secure improved strains for red, white, and subterranean clover.

Classification and antibiotic properties of Actinomycetes in New Zealand soils; deterioration of sugar syrups used in crystallisation of fruits; coliform contamination of ice cream; investigation of streptomycin formulations for control of blast of stone fruit; uptake and translocation of streptomycin by peach seedlings; investigations into absorption of streptomycin by plant foliage; studies on the antifungal activities of *Griseofulvum;* and screening antibiotics for control of plant fungal diseases.

Virus Diseases

Virus Diseases of Clover: identity, incidence, transmission and effect on yield; inheritance of immunity to pea-mosaic virus (joint project with Crop Research Division); cause and effect of big-vein disease of lettuce; effect of lettuce mosaic on yield of lettuce varieties; control of tobacco mosaic in glasshouse tomatoes; studies on cause and control of internal browning (grey wall) of tomatoes; and effect of insecticides on control of virus diseases of swedes.

Chemotherapy of plant viruses; chemistry of inhibition of virus multiplication; biochemistry of nucleic acids; and plant-virus serology.

Fruit-tree Virus Investigations (in collaboration with Fruit Research Station): identification of virus diseases of pip and stone fruits, investigations into their effect on tree growth and yield and control by heat treatment and by use of virus-free stocks and scions; and investigations into virus diseases of roses.

Plant Therapeutants

Life-history studies of the fungus (*Neofabraea perennans*) causing ripe-spot disease of apples with a view to introducing a reliable spray programme; investigations on the effect of using various therapeutants, especially phenyl mercury chloride for successive seasons, on the vigour and yield of apple trees; and maintenance of a system of certification of plant therapeutants.

Horticulture

Studies on effect of summer and winter pruning on incidence of silver leaf on peach; studies on hot-water treatment and therapeutant applications on control of chrysanthemum eelworm; investigation on improvement of propagation methods; and maintenance of a post-entry quarantine system for Department of Agriculture.

Timber Preservation

Investigations on control of sap-stain organisms in *Pinus radiata* timber; and studies on toxic effects of individual materials contained in multi-salt preservatives.

PUBLICATIONS

Additions to the Rust Fungi of New Zealand. II. *Trans. Roy. Soc. N.Z. 83*:453–63. Shirley D. Baker.

The Genus *Albugo* in New Zealand. *Ibid. 82*:987–93. Shirley D. Baker.

Second Supplement to "A Revised List of Plant Diseases Recorded in New Zealand", 1952–55. *N.Z. J. Sci. Tech. A37*:27–35. R. M. Brien and Joan M. Dingley.

Diseases and Pests of Peas and Beans in New Zealand and Their Control. *N.Z. Dep. sci. industr. Res. Bull. 114*:91. R. M. Brien, E. E. Chamberlain, W. Cottier, I. A. M. Cruickshank, D. W. Dye, H. Jacks, and W. D. Reid.

Certification of Therapeutants, 37th List. *Suppl. Orchardist of N.Z. 28 (7)*. G. H. Cunningham.

Certification of Therapeutants, 38th List *Ibid. 29 (2)*. G. H. Cunningham.

Thelephoraceae of New Zealand. Part IV. The Genus *Vararia*. *Trans. Roy. Soc. N.Z. 82L*:973–85. G. H. Cunningham.

Thelephoraceae of New Zealand. V. The Genus *Asterostroma*. *Ibid. 83*: 241–5. G. H. Cunningham.

Thelephoraceae of New Zealand. VI. The Genus *Peniophora*. *Ibid 83*: 247–93. G. H. Cunningham.

Notes on *Hypocrea citrina* (Pers.) Fr., *H. lacka* Fr., *H. pulvinata* Fel., and *H. sulphurea* (Schw.) Saac. *Kew Bulletin No. 4*:575–8. Joan M. Dingley.

"Blast", a New Approach to an Old Plant Enemy. A Serious Disease of Fruit Trees and Ornamentals. *N.Z. Gardener 12 (2)*:105, 107, 109. D. W. Dye.

Field Trials on Control of Halo Blight of Beans (*Pseudomonas phaseolicola* (Burkholder) Dowson). *N.Z. J. Sci. Tech. A37*:458–61. D. W. Dye.

Stone Fruit Blast. *Orchardist of N.Z. 28 (10)*:2–3. D. W. Dye.

Comment on the Proposed Validation Under the Plenary Powers of "immigrans" Sturtevant, 1921, as Published in the Combination "*Drosophila Immigrans*" (Class Insecta, Order Diptera). *Bull. Zool. Nomencl. 9*:242–3. R. A. Harrison.

Notes and Records of Some Pests of Economic Importance. *N.Z. Ent. 1 (5)*:10–3. R. A. Harrison.

The Diptera of Auckland and Campbell Islands. Part 1. Report on Diptera of Auckland and Campbell Islands. *Records Dominion Museum 2 Pt. 4*:205–46. (No. 20, Pt. 1, of Cape Expedition Series. Scientific Results of N.Z. Subantarctic Expedition 1941–45). R. A. Harrison.

Diffusion Impregnation of Building Timbers With Boron Compounds (Part 1). *N.Z. Timber Journal. Forestry Review 2*:28–9. K. M. Harrow.

Momentary Immersion Treatment of Timber With Boron Compounds (Part 2). *Ibid. 2*:38, 41, 43. K. M. Harrow.

Certification of Legume Seed Inoculants. *N.Z. J. Agric. 92*:277–8. A. Hastings.

Compatibility of Spray Materials Used in New Zealand on Tomatoes 1955. *Orchardist of N.Z. 28*:16–7. H. Jacks.

Disinfection of Glasshouse Soil: Control of Soil-borne Diseases and Pests by Application of Heat or Chemicals. *N.Z. Dep. Agric. Bull. 314*:12. H. Jacks.

Effective Soil Disinfection. *N.Z. Com. Gard. J. 10*:10, 12. H. Jacks.
Incompatibility of Spray Materials. *Suppl. Orchardist of N.Z. 28 (8)*. H. Jacks.
Plant Protection Appliances. *N.Z. Com. Gard. J. 10*:12–4. H. Jacks.
Plant Quarantine. IV. List of Plant Diseases and Pests Intercepted in New Zealand in 1954. *N.Z. J. Sci. Tech. A36*:608–9. H. Jacks.
Plant Therapeutants Under Test. *Orchardist of N.Z. 29*:9. H. Jacks.
Screening Tests With Fungicides for Control of Celery Leaf Spot (*Septoria apii* Chester). *N.Z. J. Sci. Tech. A37*:373–8. H. Jacks.
Testing Plant Therapeutants. *Orchardist of N.Z. 28*:2, 3.
Screening Tests With Fungicides for Control of French-bean Rust (*Uromyces appendiculatus* (Pers.) Unger). *N.Z. J. Sci. Tech. A37*: 62–7. H. Jacks and R. M. Brien.
Seed Disinfection. XI. Control of Head Smut (*Sorosporium reilianum* (Kuhn) McAlpine) of Maize. *Ibid. A37*:141–5. H. Jacks and G. J. Graham.
Compatability of Spray Materials Used in New Zealand on Apricots. 1955. *Orchardist of N.Z. 28*:32. H. Jacks and J. E. Hawkins.
Compatability of Spray Materials Used in New Zealand on Peaches 1955. *Orchardist of N.Z. 28*:16, 17. H. Jacks and H. W. Rosser.
Black Spot of Roses. Modern Methods of Control. *N.Z. Gardener 12*: 259–61. H. Jacks, A. J. Webb, and J. A. Hunter.
Seed Disinfection. XII. Glasshouse Tests for Control of Damping-off of *Pinus radiata* Seed. *N.Z. J. Sci. Tech. A37*:427–31. H. Jacks.
Orchard Spray Trials in 1954–55. Suppl. Orchardist 28 (10). H. Jacks, A. J. Webb, W. J. Biggar, R. E. Robbins, and O. Winn.
Selenium in Apples – the Effect of Applications of Selocide to the Tree and to the Soil. *N.Z. J. Sci. Tech. B37*:119–25. Helen E. Barr, P. J. Clark, and H. Jacks.
Chemotherapy of Plant Viruses. *Discovery 16*:421–5. R. E. Matthews.
Distribution of 8-Azaguanine in the Nucleic Acids of *Bacillus cereus*. *Nature 177*:271–2. R. E. Matthews and J. D. Smith.
Infectivity of Turnip Yellow Mosaic Virus Containing 8-Azaguanine. *Virology 1*:165–75. R. E. Matthews.
The Chemotherapy of Viruses. *Advances in Virus Research 3*:49–148. R. E. Matthews and J. D. Smith.
Collar-rot and Crown-rot of Apple Trees. *Orchardist of N.Z. 28*:16, 17, 19, 21. H. C. Smith.
Spore Formation in the Genus *Streptomyces*. *Nature 176*:935–6. T. R. Vernon.
Notes on New Zealand Lepidoptera. *N.Z. Ent. 1 (5)*:13. K. A. J. Wise.
Pests of Stored Products in New Zealand. II. Family Ptinidae (Coleoptera). *N.Z. J. Sci. Tech. B37*:503–8. K. A. J. Wise.

SCIENTIFIC LIAISON SERVICE

Officer in Charge: Mr N. A. Marris

ACTIVITIES AND PROJECTS

London—During the year the Scientific Liaison Officer has represented New Zealand on a number of Commonwealth scientific committees and at certain scientific conferences. These included the Executive Council of the Commonwealth Agricultural Bureaux and

the quinquennial review conference of the same organisation, the Conference on the Peaceful Uses of Atomic Energy, the Fourth Commonwealth Advisory Committee on Defence Science, and the Co-operative Research Committee meetings of O.E.E.C. Other activities have included the scientific supervision of New Zealand Defence Scientific Corps officers and National Research fellows.

Reports of visits to several scientific institutions dealing with agricultural research have been forwarded to New Zealand and, in particular, information relating to such questions as the following: certification of pesticides and recent developments in their use, role of phosphorus in plant nutrition, recent work on productivity measurement in secondary industries, use of defoliants in harvesting of clover and lucerne seed. The office has made inquiries with regard to a suitable electronic computer for New Zealand.

Washington—The work of the office has included the obtaining and forwarding of technical publications, scientific information, specimen materials, etc., and assistance to scientific visitors from New Zealand. Information on New Zealand research work has been made available to interested organisations in the United States and Canada.

SOIL BUREAU

Director: Mr N. H. Taylor

PROJECTS

Agricultural

Soil Surveys—North Island: Waiotapu (40 ch./in.), Manawatu-Rangitikei sand country (40 ch./in.), and revision of Sheet 8 – North Island soil map (4 m./in). South Island: South Island (4 m./in.), Ida Valley (40 ch./in.), Taieri Plains (40 ch./in.), and Chatham Islands (2 m./in.). Fiji: soils of Vanua Levu (2 m./in.).

Special Investigations—North Island market-garden soils; soils of Christchurch and Hamilton cities; phosphate requirements of Southland; potassium-supplying power of New Zealand and Pacific soils; residual effects of phosphate topdressings in New Plymouth black loam; sulphur in New Zealand soils; relationship of dental caries to soil type; effect of liming Taita hill soil on the composition of the pasture mosaic; soil solutions of selected soils from main soil groups; micro-method for determining cation exchange capacity and total exchangeable bases; survey of inorganic soil colloids in New Zealand soils; survey of available minerals in soils as extracted by sweet vernal; phosphate and molybdate absorption in soils; source of radioactivity of some North Island soils; moisture properties of soils in Whangarei County; laboratory testing of drainage-promoting chemicals; specific gravity of clay soils; field trials of soil "pugging" and surfactants; pF curves of Taupo pumice soils; stone movements on slopes due to frost; physical examination of Takapau soils; biological investigation of silver-tussock grassland soils: copper survey of main New Zealand soils; fungi of pakihi soils; reconnaissance survey of tussock grasslands in North Island; identification of soil Basidiomycetes by a serological method; biochemical and physiological studies on *Rhizoctonia* spp.; mycorrhizae and plant growth; fertility of a leached Niue Island soil; and fertility of Cook Island coral sand.

Forestry

Soils of Ngaumu State Forest; soils of Tairua State Forest; stability of steepland soils of Westland; soil fertility in the Golden Downs State Forest; retardation of growth in Douglas Fir for four years after planting-out in Southland State forests; chemical investigation of litter and humus of red beech; and moisture status of Westland soils.

Engineering

Corrosion of mild steel in soils; corrosion of concrete and cement-asbestos; cathodic protection of steam-bore casings at Wairakei; physical properties of New Zealand estuarine soils – comparison of 20-minute and 24-hour loading cycles, Ava bridge foundations, Kimihia open-cast working, and Manukau sewage treatment foundation; sensitivity of clays resulting from consolidation; volume changes during drained triaxial tests on sands; changes in pore-water pressure with special reference to glacial soils; foundation surveys of Mount Maunganui industrial area, Mercer steam power station, and Wairakei geothermal power station.

PUBLICATIONS

Unusual Forms of Halloysite. *Amer. Min.* *40*:122–4. K. S. Birrell, M. Fieldes, and K. I. Williamson.

Studies of Molybdenum in the Soil. *Proc. N.Z. Soc. of Animal Production.* *15*:81–5. W. B. Healy.

The Breakdown of Particles in Pumice Sands Due to Mechanical Dispersion Treatment. *N.Z. J. Sci. Tech.* *B37*:351–3. D. C. McDonald.

Soil Moisture and Physical Properties of a Westland "Pakihi" Soil in Relation to Deforestation. *Ibid.* *B37*:258–66. D. C. McDonald.

Soil Frost Studies at a High Country Station. II. *Ibid.* *B37*:267–75. M. W. Gradwell.

The Determination of Specific Gravities of Soils as Influenced by Clay-Mineral Composition. *Ibid.* *B37*:283–9. M. W. Gradwell.

Soil Studies Using Sweet Vernal to Assess Element Availability. *Ibid.* N. Wells.

Part I. Preliminary Studies. *B37*:473–82.

Part II. Molybdate Fixation in New Zealand Soils. *B37*:482–502.

Change in Base Status of a Soil after Treatment with Sulphur and Sulphuric Acid. *Ibid.* *B37*:276–82. W. M. H. Saunders and L. C. Blakemore.

Clay Mineralogy of New Zealand Soils. *Ibid.*

Part I. Electron Micrography. *B37*:314–35. M. Fieldes and K. I. Williamson.

Part II. Allophane and Related Mineral Colloids. *B37*:336–50. M. Fieldes.

Total and Radioactive Phosphorus Determinations in Small Plant Samples Using the Gravimetric Method of Lorenz. *Ibid.* *B37*:243–57. K. Strzemienski. (With a note on statistical analysis by R. M. Williams.)

Biological and Chemical Changes Following Scrub Burning on a New Zealand Hill Soil. *Ibid.* *B37*:290–313. R. B. Miller, J. D. Stout, and K. E. Lee.

Natural Radioactivity of Soils. *Ibid.* *B37*:354–68. H. S. Gibbs and J. G. McCallum.

Observations on the Determination of Total Organic Phosphorus in Soils. *J. Soil Sci. (1955) 6*:254–67. W. M. H. Saunders and E. G. Williams.

Soil Conditions in Relation to Engineering in New Zealand. *N.Z. Engineering. 10*:345–7. K. S. Birrell.

Rapid Consolidation Tests for Routine Investigations. *N.Z. Engineering 10*:407–11. R. D. Northey.

Results of Some Investigations on Two Sensitive Clays. *Ibid. 10*:403–7. P. L. Newland and B. H. Allely.

Pore Pressure and Shear Strength Tests on Earthdam Materials. *Ibid. 10*:411–6. A. J. Watt.

Current Research in Soils and Fertilisers. *Proc. N.Z. Inst. of Agric. Scientists Conf. (1955)*:34–9. N. H. Taylor, J. K. Dixon, and I. J. Pohlen.

Rhizoctonia in Natural Grassland Soil. *Nature. 117*:230–1. R. H. Thornton.

Mycelial Aggregation of Sand Soil under *Pinus radiata*. *Ibid. 177*:231–2. R. H. Thornton, J. D. Cowie, and D. C. McDonald.

Microbiology of Tussock Grassland Soil. *Proc. N.Z. Ecol. Soc. 3*:10–2. R. H. Thornton, J. D. Stout, and M. di Menna.

The Soils Problem in Reforestation in Northland. *Proc. 1st Conf. N.Z. Soc. Soil. Sci (1955)* 3–4. J. W. Levy and C. F. Sutherland.

The Growth of Exotic Forest Trees on Certain Soils at Tairua Forest, Coromandel. *Ibid.* 5–6. C. G. Vucetich and G. C. Weston.

The Pedological Value of Soil Analysis. *Ibid.* 10–1. H. S. Gibbs.

The Pumice Soils. *Ibid.* 17–9. I. L. Baumgart.

Some Chemical Aspects of Pumice Soils. *Ibid.* 19–21. J. K. Dixon and R. H. Jackman.

Moisture Relations of Taupo Ash Soils. *Ibid.* 21–3. R. Q. Packard.

Ecological Aspects of the Fauna and Microflora of Taupo Pumice Soils. *Ibid.* 24–6. R. H. Thornton, K. E. Lee, and J. D. Stout.

Plant Distribution Records (3). *Bull. Wellington Bot. Soc. (1956) 28*. A. P. Druce.

The Effect of Partial Steam Sterilisation on the Protozoan Fauna of a Greenhouse Soil. *J. Gen. Microbiol. 12*:237–40. J. D. Stout.

Response of Ciliates to Environmental Factors. *Ecology. 37*:178–91. J. D. Stout.

A Combinatorial Design for Experiments with Alternative Response. *Nature. 177*:283. K. Strzemienski.

The Ecology, Life History, and Parasitism of *Tetrahymena* (*Paraglaucoma*) *rostrata* (*Kahl*) Corliss. *J. Protozoa 1*:211–5. J. D. Stout.

Saprophilus muscorum Kahl, a Tetrahymenal Cilate. *Ibid. 3*. Part 1. J. D. Stout.

Excystment of *Frontonia depressa* (Stokes) Penard. *Ibid. (1956) 3*. Part 1. J. D. Stout.

Distribution of Phosphorus in Profiles and Particle Size Fractions of Some Scottish Soils. Part 1. *J. Soil. Sci. 7 (1)*. E. G. Williams and W. H. M. Saunders.

Some Soils of Tussock Grasslands. *Proc. N.Z. Ecol. Soc. 3*:9–10. J. D. Raeside.

TOBACCO RESEARCH

Station Director: Mr R. Thomson

PROJECTS

Seedling Bed Work

Alternatives to steam sterilisation for the control of weeds and disease; rate of seeding; and testing new insecticides and fungicides on tobacco seedlings.

The Crop in the Field

Fertilisers—Optimum use of phosphate and potash, with and without magnesium response of tobacco to minor elements copper, zinc, manganese, and molybdenum; effect of boron on yield and quality of different varieties; application of fertilisers, most suitable time and form in which to apply nitrogen; and demonstration plots to illustrate various deficiencies.

Cultural—Effect of spacing of plants on size of leaf and yield; control of lateral growths by chemicals; and irrigation experiments – use of water at time of planting, studies of the moisture requirements of the tobacco crop.

Plant Breeding—Breeding for resistance to black root-rot, mosaic, verticillium wilt, *Phytophthora* canker, and studies of inheritance.

Variety Trials—Testing of overseas varieties and locally developed lines.

Seed Production—Maintain a supply of seed for the industry and build up a reserve.

Kilns and Curing—Fundamental work on curing in cabinets under controlled conditions, and kiln design in co-operation with the Dominion Laboratory.

PUBLICATION

Resistance of Tobacco Varieties to Black Root-rot. *N.Z. J. Sci. Tech. B37*:100–2. A. G. McLeod.

WHEAT RESEARCH INSTITUTE

Director: Mr E. W. Hullett

PROJECTS

Services—Determination of the milling and baking qualities of new wheats produced at the Crop Research Division; flour and wheat testing service for millers, bakers, and the Wheat Committee; technical advisory services for millers, bakers, and other flour users (this includes laboratory investigation of *ad hoc* problems, and visits by officers to mills and bakeries); and fortnightly issue to all bread bakers of lists giving the quality and optimum treatment for all New Zealand flours.

Other Projects—Study of factors affecting dough fermentation and treatment in bakeries (current emphasis is on the control of final proof rates to suit automatic proovers, and on dough moulding); study of the causes of convective heat and steam losses from ovens, and the finding of methods to reduce these losses; further development and application

of methods for planning and recording operations in automatic bakeries; research into the biochemisty of ferments; further work on any of a number of practical milling and baking problems that can be studied only when particular conditions arise; and investigation aimed at encouraging the use of New Zealand milk powder overseas.

PUBLICATIONS

The Role of Methoxy-p-Benzoquinone in Bread Making. *Chemistry and Industry* (29 Oct. 1955):1424. R. W. Cawley and E. W. Hullett.
Facts About Bread. *N.Z. Dietetic J. 9*:7. E. W. Hullett.
Report to Bakers' Conference. *N.Z. Baker and Confectioner* (April 1955).
Steam in Ovens. *Ibid.* (Sept. 1955).
Further Work on Steam in Ovens. *Ibid.* (Nov. 1955).
Extracts from Technical Reports. *Ibid.* (May, Sept., Oct., Nov., 1955).

INCORPORATED RESEARCH ASSOCIATIONS

DAIRY RESEARCH INSTITUTE (N.Z.)

Director: Professor W. Riddet

The financial year of the institute ends on 31 July next, after which a separate report will be issued. The investigations under way include studies of the following subjects:

Cheesemaking—Maintenance of starter cultures in active condition and search for new useful strains; study of the bacterial flora in ripening cheese; study of the effects on flavour and texture of cheese of pure cultures of bacteria added to cheese milk, and also their power to produce discoloration; large-scale trials on the relationship of cheese-storage conditions to the incidence of open texture and discoloration in Cheddar cheese; wrapping materials for packaging of cheese for retail sale; suitability of waxes of different types for the waxing of cheese; causes of cracking of cheese on exposure to the atmosphere; prevention of crowning of cheese wax; influence of storage conditions or moisture loss from cheese; and production of dry powdered cheese.

Buttermaking—Phospholipid distribution in separation of milk and in churning of cream; factors influencing rate of steam distillation of taints from cream; change in size of fat globules in processing of cream; flavour and keeping quality of butter made from cream treated with starters of different types; causes of spotted and streaky colours in butter; laminated wrapping materials for butter; charting of seasonal changes in characteristics of New Zealand butterfat over a period of years; effects of oils used as prophylactics for bloat in cows on the flavour of milk, cream, and butter, and on the properties of butterfat.

Casein—Studies of casein-washing operations; studies on the drying of casein and on the performance of casein dryers; particle-size tests of casein during milling and sieving; and causes of variation in viscosity of casein solutions.

Dried Milk—Study of the fundamental chemistry of the browning reaction between amino-acids and sugars.

Dairy Process Engineering—Heat transfer rates during ice formation and melting in farm refrigeration units, heat transfer rates of cream, and continuation of studies on equipment for distillation of taints from cream.

Engineering Advisory Service Section—This section of the institute's activities, inaugurated during the past year, is a service organisation which carries out tests and gives advice for which individual dairy companies make payment; service in the fields of boiler selection and operation; steam economy; air conditioning of cheese-curing rooms; suitability of cream-deodorising equipment; advice on modernising of factory plant and layout; and mechanisation of cheese manufacture.

Dairy Husbandry—Influence of changes in feeding conditions and changes in stage of lactation on the composition of milk and on the properties and vitamin A content of butterfat; causes of changes in the vitamin A content of butterfat; and relation of the carotene and vitamin A contents of blood to vitamin A and carotene contents of butterfat.

PUBLICATIONS

Steam Stripping of Taints from Liquids. *J. Dairy Res.* J. K. Scott.
Part I. An Analysis of Processing Methods With Particular Reference to the Vacreator. *21*:354.
Part II. Counterflow Stripping With Particular Reference to Possible Use of Vacreator Equipment. *21*:370.
Part III. Batch Stripping With Particular Reference to Equilibrium Values from Batch Data. *22*:302.

The Properties of N.Z. Butters and Butterfats. IV. Refractive Index and the Density of the Butterfat. *J. Dairy Res. 21*:383. A. K. R. McDowell.

The Effect of Undernutrition After Calving on the Quantity and Composition of the Milk Produced by Dairy Cattle. *J. Agric. Sci. 45*: 246. D. S. Flux and M. R. Patchell.

The Steam Demands of Dairy Factories. *Aust. J. Dairy Tech. 9*:95. J. K. Scott.

The Influence of Variations in Cheese-making Procedure on the Expulsion of Moisture from Cheddar Cheese Curd. *Aust. J. Dairy Tech. 9*: 103. H. R. Whitehead and W. L. Harkness.

The Use of Monozygous Cattle Twins in Experiments. *Indian Dairyman 7*:5. D. S. Flux.

Grease Absorption Test for Vegetable Parchment. *Aust. J. Dairy Tech. 9*:108. W. R. Mummery.

A Chemical Investigation of the Volatile Flavour Principle of Cheddar Cheese. *J. Dairy Res. 22*:219. J. C. Dacre.

New Zealand Practice in the Control of Temperature and Humidity as Applied to Factory Storage of Export Cheese. *Dairy Industries 20*: 495. J. K. Scott.

Spotted Colour in Butter. *N.Z. J. Sci. Tech. A36*:527–47. R. M. Dolby.

A Comparison of the Milk Production of Cows on Different Systems of Break Feeding. *Ibid. A36*:557–9. D. S. Flux and M. R. Patchell.

Steam Distillation of Taints from Cream. 1. Theoretical Considerations and Properties of the Reference Substances, Diacetyl and Acetoin. *J. Dairy Res. 22*:311. F. H. McDowall.

The Effect of Salt and of Antioxidants on the Keeping Quality of Butter. *J. Dairy Res. 22*:349. A. K. R. McDowell.

Adjustment of the Casein/Fat Ratio of Milk for Cheesemaking. *N.Z. J. Sci. Tech. A37*:68–82. R. M. Dolby and W. L. Harkness.

Vapour/Liquid Equilibrium Measurements by a Continuous Method. *Ibid. B37*:1–11. F. H. McDowall.

Insoluble Protein in Commercial Lactic Casein. *Aust. J. Dairy Tech. 10*:99. W. R. Mummery.

Factors Affecting the Non-fatty Solids in Milk With Particular Reference to the New Zealand Town Milk Supply. *Proc. N.Z. Soc. Animal Prod. 15*:132. I. L. Campbell, D. S. Flux, and M. R. Patchell.

The Effect of Some Endocrine Factors on Mammary Gland Growth and Lactation. *Ibid. 15*:95. D. S. Flux.

Milk Cooling on Town Supply Farms. *Town Milk (Oct. 1955)*:9. J. K. Scott.

Effect of Treatment of Dairy Pastures with B.H.C. and D.D.T. on the Flavour and Composition of Milk, Cream, and Butter. *N.Z. J. Sci. Tech. A37*:146–55. F. H. McDowall.

Variations in the Composition of Milk. *D.R.I. Pub. No. 277*. D. S. Flux, M. R. Patchell, I. L. Campbell, and F. H. McDowall.

NEW ZEALAND FERTILISER MANUFACTURERS' RESEARCH ASSOCIATION (INC.)

Director: Dr B. W. Doak

PROJECTS

Long-term effect of various phosphatic fertilisers used with and without lime on the chemistry of the soil; influence of granule size on efficiency of granulated super as pasture topdressing; effect of the calcium sulphate contained in superphosphate; the effect of various cobalt compounds including chelates on the availability of cobalt to pasture plants; sulphur in soils.

NEW ZEALAND POTTERY AND CERAMICS RESEARCH ASSOCIATION (INC.)

Director: Mr I. C. McDowall

PROJECTS

Geology and ceramic resources of the Huntly district; the design of a rectangular down-draught kiln for salt-glazed pipes; clay supplies at Abbotsford; deterioration of brick facing on a telephone exchange; detergent for crockery; the treatment of brickwork with oils; and properties of clays used at Auckland: Part 1, papa and sandstone; Part 2, plastic clays.

PUBLICATIONS

Dampness in Buildings: Part 1, Moisture Penetration. *Clay Products Bull. 3.*

Dampness in Buildings: Part 2, Condensation. *Clay Products Bull. 4.*

N.Z. Pottery and Ceramics Research Association: Activities. *N.Z. Engg. 10*:166–7.

A Method of Aligning Pipes. *Ibid. 10*:270.

NEW ZEALAND LEATHER AND SHOE RESEARCH ASSOCIATION (INC.)

Director: Mr F. W. Woodroffe

PROJECTS

The use of low alkali depilatory paints; the modified pickling process; control of hard spot on wet salted calfskins; hot pitting of vegetable-tanned sole leather; action of perspiration on the phosphate anion in chrome leather; rapid tannage of sole leather.

NEW ZEALAND WOOLLEN MILLS RESEARCH ASSOCIATION (INC.)

Director: Dr L. F. Story

PROJECTS

Woollen Ring-spinning—Effect of different drafts and different speeds of false-twister tubes.

Worsted Combing—Effect of varying the amount of oil applied.

Effect of Shearing Time on Wool—Further observations on the cross-bred and Corriedale clips; mill processing of the 1955 Corriedale wool.

Stimulation of Wool Growth—Effect of thyroxine, with observations of the growth of wool and probably a manufacturing trial.

Comparative Study of N.Z. 48s Quality Wools from various sources.

PUBLICATIONS

Effect of Shearing Time on Wool. Parts I, II, and III. *N.Z. J. Sci. Tech. A37*:267–86. L. F. Story.

Effect of Shearing Time on Wool in New Zealand. *Proc. Int. Wool Textile Res. Conf., C.S.I.R.O.,* Australia. L. F. Story.

Some Recent Discoveries about the Structure of Wool. *Wool. 2 (3)*: 17–9. D. A. Ross.

Wool Research in New Zealand. *Modern Mfg. 7 (4 and 5)*:19–25. L. F. Story.

RESEARCH INSTITUTE OF LAUNDERERS, DRYCLEANERS, AND DYERS OF NEW ZEALAND (INC.)

Research Officer: P. Carlyon Coates

PROJECTS

Education of members or their staff by demonstrations on the institute's plant at technical conferences; testing of laundry test-pieces for whiteness retention and strength retention; testing to determine the effect of carefully controlled bleaching; investigation of blues and optical bleaches; trials of permanence of marking inks; tests on relative depreciation of goods in use and during washing; tests on relative expectation of life of various textiles; tests on shrinkage of fabrics in washing; survey of commercial laundries and drycleaning plants; investigation into causes of stains and methods of removal; investigation into causes of textile damage in articles processed in laundries and drycleaning plants; testing serviceability of new fabrics in relation to laundering and drycleaning; examination of diatomaceous earths for suitability as filter aids in drycleaning plants; investigation of the resistance to drycleaning solvents of protective gloves made of synthetic rubbers; process tests on commercial and institutional laundries.

GRANTS-IN-AID TO OTHER INSTITUTIONS

Grants for research in universities and other institutions in 1955–56 were as follows:

	£	£
Auckland University College: Seagrove Radio Research Station		4,000
Australian and New Zealand Association for the Advancement of Science		750
National Institute of Oceanography (London)		2,500
Canterbury Agricultural College		8,000
Canterbury University College—		
Research on meteors	1,280	
Industrial Development Department	8,000	
		9,280
Carter Observatory		2,250
Cawthron Institute		11,364
Commonwealth Agricultural Bureaux		14,080
Dr H. H. Allan (revision of Cheeseman's *Manual of New Zealand Flora*)		350
Massey Agricultural College		8,000
Royal Society of New Zealand		4,000
Victoria University College—		
Ultra-high-frequency Research	700	
Iron Sands Investigation	2,000	
		2,700
Incorporated Research Associations		47,210
Scott Polar Research Institute		100
Soil Bureau Exhibition		50
		£114,634

Details of projects being conducted at some of the institutions receiving grants are shown below.

CAWTHRON INSTITUTE

Director: Sir Theodore Rigg

Aided by grants from the Department of Scientific and Industrial Research, work has been carried out on a wide range of problems connected with the tobacco, hop, fruit, and tomato industries of the Nelson district. Other important work has included entomological, soil, and plant-nutrition studies. The institute collaborates with the Department in entomological, tobacco, and hop investigations (see under separate headings and Secretary's report).

PROJECTS

Fruit Research—Work has included trace-element studies with raspberries; relative value of borax and pandermite in the control of boron deficiency; recording of yields on the apple stock blocks at Annesbrook orchard; and tests of raspberry varieties and fertiliser experiments at the Marsden Research Farm.

Hop Research—The institute collaborates with the Department in the conduct of research for the advancement of the hop industry. Investigations at the institute comprise: disease surveys, chemical control of black root-rot, nutritional studies of *Phytophthora cactorum;* chemical analyses of hops grown at the Hop Research Station; and the conduct of hop manurial experiments at the Marsden Research Farm.

Plant Nutrition—Continuation of trace-element studies with different Nelson crops, the studies involving chemical determinations of copper, boron, manganese, and molybdenum in both leaves and fruits; and detailed studies of resins, sugars, and starch in hop cones and roots.

Soil Investigations—Continuation of soil and land-use surveys of eastern foothill country bordering Waimea Plains; conduct of molybdenum trials on pastures and farm crops; and chemical analyses of problem soils where used for tobacco, fruit, and tomato culture.

Tobacco Research—The institute collaborates with the Department in the conduct of tobacco research. Investigations at the institute comprise disease surveys, and resistance tests of different varieties of tobacco against black root-rot and canker (*Phytophthora parasitica*). The institute analyses tobacco-leaf samples from the fertiliser, cultural, and curing experiments of the Tobacco Research Station.

Tomato Investigations—Continuation of studies relating to the incidence and control of "cloud" and other physiological disorders of tomatoes; the effect of plant nutrients on the quality of tomatoes; and tests of disinfectants for the treatment of both glasshouse and outside tomato soils.

PUBLICATIONS

Boron Deficiency Symptoms in Raspberries. *N.Z. J. Sci. Tech. A36.* 1955. R. J. Monk.

Results of Research on Tomatoes at Cawthron Institute. *N.Z. Com. Grower.* Volume 11, No. 2.

UNIVERSITY COLLEGES

CANTERBURY AGRICULTURAL COLLEGE

Director: Dr M. M. Burns

PROJECTS

Animal Husbandry Department—Corriedale progeny test, fat-lamb sire trials; Border Leicester cross trials; thyroxine implantation; and wool growth.

Farm Machinery—Small-seeds harvesting; and investigations of reactions of mounted ploughs on tractors.

Entomology Department—Red-clover pollination; and seed setting and studies on *Thysanoptera* on cocksfoot.

Field Husbandry Department—Pasture mixtures for light land; grazing lucerne agronomy trials; and grazing lucerne improvement and testing.

Microbiology Department—Contamination of chilled beef by micro-organisms; *Rhizobium* inoculation of legumes, chemical control of wheat powdery mildew.

Soils Department—The nitrogen cycle in grassland soils; the nutrition of legumes; and lime studies.

Veterinary Department—The evaluation of treatments used in ovine pregnancy toxaemia.

Wool Department—Fleece rot.

PUBLICATIONS

The Influence of Method of Rearing as Hoggets on the Life-time Productivity of Ewes. *N.Z. J. Sci. Tech. A37*:214–28. I. E. Coop and V. R. Clark.

Spoilage in Frozen Peas. *Ibid. B37*:15–9. A. P. Mulcock.

The Effects and Interactions of Molybdenum, Lime, and Phosphate Treatments on the Yield and Composition of White Clover, Grown on Acid, Molybdenum Responsive Soils. *Plant and Soil VI, No. 2*: 201–20. T. W. Walker, A. F. R. Adams, and H. D. Orchiston.

The Effects and Interactions of Sulphur, Phosphorus, and Molybdenum on the Growth and Composition of Clovers. *N.Z. J. Sci. Tech. A36*: 470–82. T. W. Walker, A. F. R. Adams, and H. D. Orchiston.

Sulphur Responses on Pastures in Australia and New Zealand. *Soils and Fertilisers. XVIII*:185–7. T. W. Walker.

Sulphur Responses in Australasia. *World Crops 7:* No. 11. T. W. Walker.

Studies in Use of Agricultural Limestone. *N.Z. J. Sci. Tech.* B. L. Elphick.

I. Chemical and Physical Properties of South Island (N.Z.) Agricultural Limestones. *A36*:134–66.

II. Solubility of Limestone in Acid Soil as Influenced by Particle Size. *A37*:156–73.

III. Solubility of Limestone in Acid Soil as Influenced by Type of Stone and Particle Size. *A37*:241–58.

Faults in New Zealand Wool. *Lincoln College Technical Publication No. 12*. A. E. Henderson.

CANTERBURY COLLEGE INDUSTRIAL DEVELOPMENT DEPARTMENT

Director: Mr T. R. Pollard

Another successful year, both from the financial and from the technical aspects, has been completed. The number of projects, large and small, handled for industry have totalled 560, a small increase over last year. The total financial recovery for this year has been £15,600 as compared with £13,200 the previous year, but the industrial work has dropped from £8,300 to £6,600, due to this Department's accepting from the D.S.I.R. a large project involving the construction of three panoramic ionosondes required for the N.Z. International Geophysical Year. One of these sets has to be sent to McMurdo Sound in December 1956. Notwithstanding certain difficulties of operation, the C.C.I.D.D. has been able to operate within the grants-in-aid. Canterbury College expects to provide extra laboratory space of 650 square feet during the coming year.

PROJECTS

A gamma-radiation detector developed by this department for the Lyttelton Harbour Board's dredger *Canterbury*, has been in successful operation for the past few months. The board has now asked for an investigation as to whether the information from this detector can be utilised to operate automatically the discharge valves.

Further work has been done on the glass-bevelling machine, but trouble has been experienced with the diamond cutting-wheels and work on the project is held up pending further information and new wheels being received from England.

A high-speed selector switch for strain-gauge equipment was developed and is in successful operation at Lincoln College after considerable initial difficulties.

A large amount of special equipment was designed and made for the new laboratories of a malting company.

Two successful electronic controls were developed for a printing works, one to pre-determine at high speed batches of cards, and the other to register automatically the labels in a bag-cutting machine.

Work is proceeding on a special labelling device for a flour mill.

Assistance was given to the Physics Department of Otago University in the design and making of high-tension equipment for their Van der Graaf generator.

Two wool compression machines have been designed and made, one for Canterbury Agricultural College and one for the Wool Research Association in Dunedin.

The major effort of the department has been directed to the panoramic ionosondes. The work is divided into completing the prototype and the building of two new units, the prototype to be installed at Godley Head, the second unit at Scott Base, McMurdo Sound, and the third to go to Rarotonga. These three units will form a valuable part of the I.G.Y. programme in ionospherics.

MASSEY AGRICULTURAL COLLEGE

Principal: Professor G. S. Peren

PROJECTS

Sheep-breeding experiment; inhibition of worm parasites; epidemiology of round worm parasites; pampas research; pasture manuring under rotational grazing; mole drainage; tile drainage; farm drainage.

Genetics, Mendelian relationships; fibre type studies.

Milk supply of the Romney ewe; wear in sheep's teeth; endocrinology of reproduction in the sheep; study of mammary-gland growth and function.

Measurement of levels of hormones in the circulation of animals; nutritive value of whey for fattening pigs; utilisation of carotene by animals.

PUBLICATIONS

Multifactorial Inheritance of Halo-hair Abundance in New Zealand Romney Sheep. *Aust. J. Agric. Res. 6*:608–23. F. W. Dry.

The Dominant *N* Gene in New Zealand Romney Sheep. *Aust. J. Agric. Res. 6*:725–69. F. W. Dry.

Growth of Horns in Sheep. *Aust. J. Agric. Res. 6*:770–5. F. W. Dry.

The Recessive *N* Gene in New Zealand Romney Sheep. *Aust. J. Agric. Res. 6*:833–62. F. W. Dry.

The Genetics of the Sheep. *Advances in Genetics. Vol. 8.* (Academic Press, New York). A. L. Rae.

Breeding for Higher Fertility. *Sheepfarming Annual.* (Published by Massey College):41–7. A. L. Rae.

Functional and Morphological Studies of Hormonally Developed Udders with Special Reference to the Effect of "Triggering" Doses of Oestrogen. *Journal of Endocrinology 13*:46–58. G. K. Benson, A. T. Cowie, C. P. Cox, D. S. Flux, and S. J. Folley.

The Value of Some Steroids in Replacement Therapy in Adrenalectomised and Adrenalectomised-Ovariectomised Lactating Rats. *Ibid. 12*: 57–68. 1955. D. S. Flux.

The Effect of Some Endocrine Factors on Mammary Gland Growth and Lactation. *Proc. N.Z. Socy. Animal Production. 15*:95. 1955. D. S. Flux.

A Comparison of the Milk Production of Cows on Different Systems of Break Feeding. *N.Z. J. Sci. Tech. A36*:557–9. D. S. Flux and M. R. Patchell.

The Use of Monozygous Cattle Twins in Experiments. *Indian Dairyman. VII*:5. D. S. Flux.

Variations in the Composition of Milk. *Dairy Research Institute (N.Z.) Publication No. 277* (1955). D. S. Flux, M. R. Patchell, I. L. Campbell, and F. H. McDowall.

SEAGROVE RADIO RESEARCH STATION, AUCKLAND UNIVERSITY COLLEGE

Research Fellow in Charge: Dr H. A. Whale

The Seagrove Radio Research Station is primarily engaged in studying paths that radio transmissions take over long distance circuits, such as between New Zealand and United Kingdom. In addition to receiving a grant of £4,000 from D.S.I.R., the Post and Telegraph Department and National Broadcasting Service contributed £2,000 and £500 respectively during the past year. The Auckland University College also contributes to the operation of the station.

PROJECTS

Rotating Radio Interferometer—The observation of reception angles in azimuth and innovation of radio signals from United Kingdom and European stations have been made continuously throughout the year. The equipment has been adapted for measurement on a special series of pulse transmission from Slough, U.K., and the results of this work have proved exceptionally valuable.

Automatic Direction Finder—During the year the automatic direction finder for following rapid bearing fluctuations was completed. The object of this work is to attempt to relate the character of the fluctuations to ionospheric conditions. A considerable amount of data have been obtained and the work is being published in the *Proceedings of the Physical Society,* U.K. This research was also assisted by a University of New Zealand research grant.

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